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Glimpses of an Unseen World

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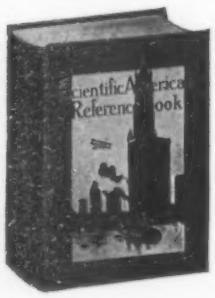

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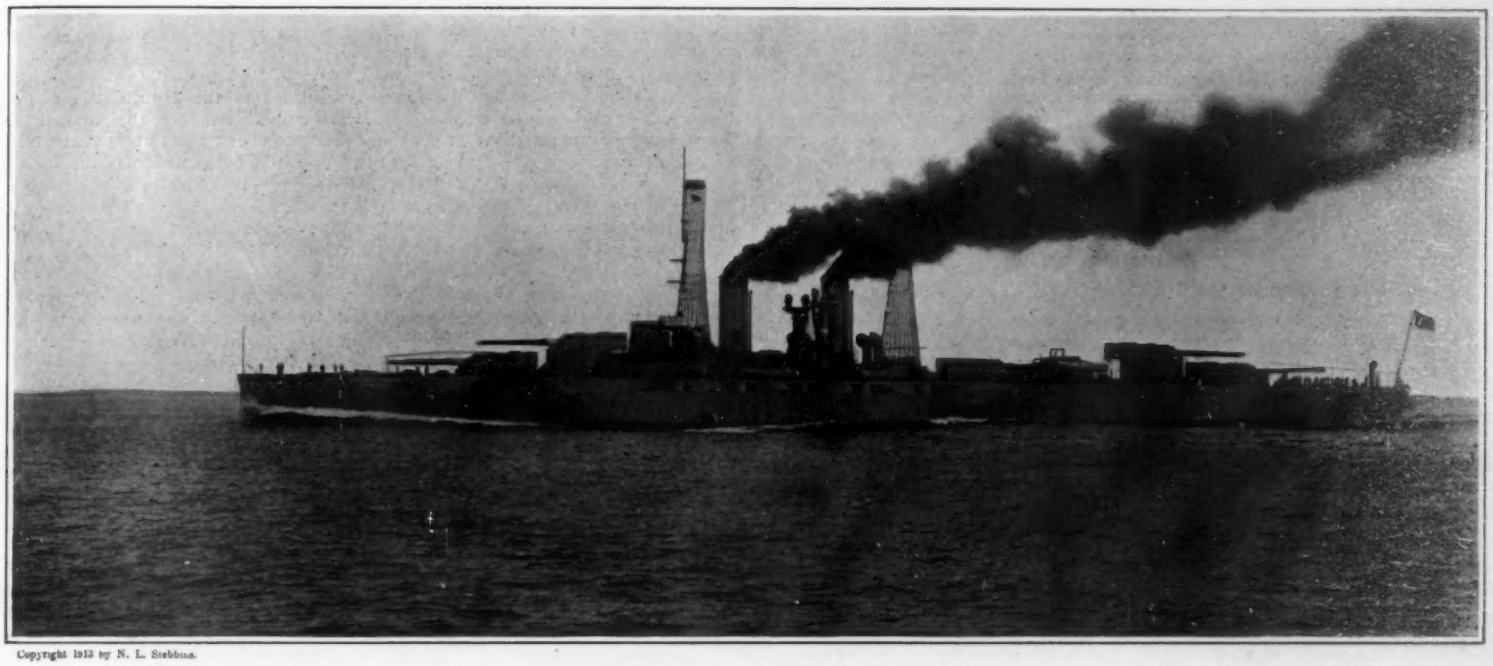

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Length on water line, 565 feet. **Beam,** 95¼ feet. **Displacement,** 27,000 tons. **Guns:** Ten 14-inch, twenty-one 5-inch, four submerged 21-inch torpedo tubes. **Armor:** Belt, 12-inch; turrets, 14-inch.

The 27,000-ton "Texas," our first super-dreadnought.

The First Super-Dreadnought of the U. S. Navy

The "Texas" Armed With Ten 14-inch Guns, Makes Twenty-two Knots

IN 1910 Congress authorized the construction of two battleships which possess special interest because of the fact that they are the first to be armed with the new 14-inch, 45-caliber gun. For many years—to be exact, since the year 1898, when the "Maine" class of battleships made its appearance—the principal weapon mounted on United States battleships has been the 12-inch gun. This piece was 40 calibers in length as mounted on the "Ohio" and "Georgia" classes comprising eight ships; 45 calibers long as mounted on the fourteen battleships of the "Louisiana," "Idaho," "Kansas," "South Carolina," "Delaware" and "Utah" classes, and 50 calibers in length as mounted on the "Arkansas" and "Wyoming."

The appearance in the British navy in 1910 of the "Orion," the first so-called super-dreadnought, marked a return in the navies of the world to guns of a heavier and larger caliber than 12 inches. The "Orion" carried a 45-caliber 13½-inch gun, and she showed a great advance in gun power over existing ships. The Bureau of Ordnance of our Navy, however, with wise prevision, had foreseen the probability of a return to heavier guns; and they had built and tested a fine 14-inch rifle, 45 calibers in length, with which, after the appearance of the "Orion," it was determined to arm our future battleships. The two sister vessels "Texas" and "New York" are the first to be armed with this formidable piece.

The 14-inch gun is 54 feet long, weighs 63.3 tons, has a muzzle velocity of 2,600 feet per second, and the weight of its shell is 1,400 pounds as compared with the shell of the 12-inch gun which weighs 870 pounds. The muzzle energy of the 14-inch shell is 65,687 foot tons. Its extreme range as mounted in the ship is 21,000 yards, and it can penetrate 15.9 inches of Krupp armor at a range of 10,000 yards. The shell carries a much larger bursting charge of high explosive than the 12-inch shell, and because of this and of its greater energy, its destructive effect, whether it penetrates or detonates against the outside face of the armor, will be much greater than that of the lighter shell.

Except for the fact that the "Texas" carries one turret less, her general appearance is very similar to that of the "Arkansas" and "Wyoming." Her particulars as to dimensions are as follows: Length on water line, 565 feet; beam, 95¼ feet; mean draught, 28½ feet. Her normal displacement is 27,000 tons as against the 26,000 tons of the "Wyoming." Her full load displacement is 28,067 tons. She is built as a flagship, and has accommodation for 1,070 officers and men. She is protected by a continuous belt of armor 12 inches in maximum thickness, tapering toward the ends, and above this is a belt of slightly less thickness extending to the gun deck, which deck, amidships, is protected by 6 inches of armor. The turrets carry 14 inches of armor.

The armament consists of ten 14-inch guns, mounted in pairs in five turrets, two forward, the after one firing over the roof of the forward turret, and three aft of the mainmast, disposed as shown in our illustration. For protection against torpedo attack there is a battery of twenty-one 5-inch guns, ten of which are mounted behind 6-inch armor, amidships on the gun deck, the others being disposed, four forward, four aft, two on the superstructure abreast the conning tower, and one mounted on the gundeck astern.

The "Texas" is a decidedly handsome ship. She is like the "Wyoming" and "Arkansas" in carrying her main deck flush from stem to stern—there being no break from the forecastle deck to the main deck as in the "Delaware" and "Utah." The main deck consequently rises from a freeboard of 18 feet aft to 25 feet forward, and the long, unbroken sweep gives a particularly pleasing outboard profile to these ships.

The "Texas" has vertical, triple-expansion, four-cylinder engines driving two propellers. The designed horse-power is 28,100 for a speed of 21 knots. This, on the trial at Rockland, was easily exceeded, the speed secured being 22 knots, with a maximum on one run of 22¼ knots. In common with all of our greater ships, the "Texas" has a wide radius of action. She can carry a maximum of 2,850 tons of coal and 124 tons of oil. The sister ship "New York" is being built at the New York navy yard, where she is rapidly approaching completion. She is practically a duplicate of the "Texas," except as regards her motive power, which will consist of Parsons turbines driving four propellers.

A Tire Tread That Can be Reversed.—In patent No. 1,070,440, Clark Francis Fish of Allentown, N. J., shows a removable tire tread made thick along its center and thinner toward each edge, where it is adapted to co-operate with fastening devices. When worn on one side the tread can be reversed, a filling piece being provided for application between the tread and the tire case when the tread has become worn and is reversed.

The Water Supply of Paris

SHOULD the additional water that the city of Paris requires be brought from the Loire River, the expense will be some $80,000,000. Such water is of good quality, but as the quantity is but 500,000 cubic meters per day, the project has the drawback of being but a temporary one, soon needing to be amended. A much more satisfactory plan will be to bring the water from Lake Leman, that is from the Rhone, where it flows out of the lake. As the volume is twenty times what would be taken now, there is ample scope for any future increase, and it will always be possible to take off what is needed for the city's consumption. To bring one million cubic meters per day to Paris would cost $120,000,000 or one half more than the above project, but the amount of water would be doubled and the supply would be carried out on much better conditions. As to the purity of the water, it need only be mentioned that Geneva, Lausanne and other places on the lake never suffer from typhoid and other epidemics known at Paris, and even then they take the water directly from the lake without the precautions which would here be used. The excellent quality of the water is recognized by chemists and bacteriologists of all countries.

Birds As Consumers of Food

IT may not be thought that of all animals, birds are among the largest eaters. This means, of course, in proportion to their weight. Some birds are known to consume two and one half times their weight of food in 24 hours. The heron, which has a light weight of 4 pounds in spite of its size, is a striking example. One was lately caught which had just swallowed two trout of 1½ and 2 pounds. Wild pigeons are among the foremost eaters, and they make a most copious repast whenever an abundance of food is found. Thus a single pigeon picked up 1,000 grains of wheat in one day.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Future of the Dirigible

OUR contemporary, *The Engineer*, of London, whose attitude to inventions of the bolder type is nothing if not conservative, affirms that the ill-fated "'L. 2' has ceased to exist because it and its brethren of all types, Zeppelin or otherwise, are mechanical absurdities designed in defiance of Nature's forces."

So much for the ship of the air; and yet it comes to our mind that some three quarters of a century ago, the ship of the sea was subjected to a similar wholesale condemnation. History (or is it tradition?) relates that a certain worthy doctor, in the days when it was proposed to build a steamship to cross the Atlantic, proved to an absolute demonstration that such a ship would sink under the load of fuel which it would be necessary to put aboard to carry her from coast to coast.

In all candor we have to confess that, in the earlier years of Zeppelin's experiments and those of Lebaudy and others, we were as skeptical as to the success of the airship as *The Engineer* was and evidently continues to be; but we are free to admit that in view of the steady creeping up of the speed of the dirigible and the continuous increase in its radius of action, and after seeing the Zeppelins daily traversing the air with evident stability and with from two to three times the speed of the steamship, we have come to the conclusion that the dirigible has an assured future and a useful field of work.

Conservatism is a most valuable quality and necessary to the orderly development of invention; and there is no doubt that the very intelligent analysis made by our contemporary of the various disasters which have happened to former Zeppelins has rendered good service in the development of the art. But when the same journal states that the obvious lesson of the recent disaster is that "no dirigible balloon has yet been constructed which fulfilled its function otherwise than by dodging the forces of nature" the least that can be said is that the statement is flatly contradicted by the facts. So far from dodging the forces of nature, both the construction and the operation of the dirigible are based, as in all successful inventions, upon a recognition of the laws of nature and a co-operation with them in securing the desired results. The buoyant, engine-propelled, rudder-controlled dirigible covering, at a speed of forty to fifty miles an hour, the greater part of a thousand miles of travel within the twenty-four hours, is built with the same intelligent recognition of and co-operation with the forces of nature which during the past century has brought the steamship to the stage of perfection represented by an "Imperator" or a "Mauretania." The Zeppelin "L. 2" which embodied only about sixteen years of development of the airship, was capable of traveling all day at a speed of 55 miles an hour, and at a cruising speed of 35 miles was capable of making a continuous flight of 2,000 miles.

In the face of such facts, and admitting that this stage of development has been reached at the cost of many deplorable failures, we think it is altogether too early to state that the Zeppelin and all its brethren of whatsoever type "are mechanical absurdities designed in defiance of Nature's forces."

But to leave generalities and come more closely to our text, we invite the attention of the *Engineer* to the fact that these airship disasters are entirely preventable. They may be classed under two heads: Those that are due to collisions with the ground or the sheltering hangars, and those that have been caused by explosions. As regards the former, the SCIENTIFIC AMERICAN has always held that the ship of the air should be maintained in the air, and should never, except in emergency, court the risks of destruction which are entailed in making a landing upon the earth's surface. Many years ago we pointed out that the logical provision for landing would be to erect lofty steel mooring towers (docks, if the name be preferred), to which the airship would come up from the leeward, casting her anchor into a suitable circular framework, attached to a turntable which would allow the dirigible to float always to the leeward. Pipelines for gas and fuel would extend to the top of this tower, and by means of flexible connections, the floating dirigible could secure such replenishment as was needed. Elevators would carry passengers and crew between the landing stage and the ground.

Now under such arrangements the airship would remain afloat until such time as repairs might be necessary, when, like the ship of the sea, she would enter drydock. We believe that the function of the shed or hangar should be confined purely to docking work, and that the dirigible should be docked only in calm weather.

As regards the risks of explosions, we are of the opinion, as stated in a recent issue, that these are entirely preventable. So far as the engines and their fuel are concerned, there is no greater risk of explosion in the motive power of an airship than there is in that of an automobile or of a Diesel-engine-driven steamer. The risk comes from the leaking hydrogen and its mixture in explosive proportions with air; and this as we showed in a recent issue, can be successfully guarded against by providing blowers of sufficient capacity to sweep the escaping gases from within the outer envelope.

The dirigible has an assured future, at least as an arm of the military service; and the many disasters of the past will no more prevent its inevitable development, than did the shocking fatalities of the sea which happened to the steamship in the earlier decades of its active service.

A Cycle in Naval Gun Construction.

THE fact that our latest battleship, the "Texas," which has just completed its trials, carries as its principal weapon a 14-inch 63½-ton gun, and the recent launch of the "Queen Elizabeth," which is to mount a 15-inch 90-ton gun as its main armament, coupled with our knowledge of the fact that one leading naval power is just about completing for test a huge piece of 16 inches caliber, reminds those of us who have followed naval construction during the past twenty-five years that naval armament, at least so far as regards the caliber and weight of its guns, has been developing in a circle; and that with respect to size and power we have, relatively, reached the position from which we started some three decades ago.

To be convinced of this, let us consider the armament of the leading battleships of those navies of the decade 1880 to 1890 that stood in the front rank. The most powerful ships of that period were, strange to say, ships of what most of us have thought was a purely modern type, i. e., the battle-cruiser. The Italians, who have ever been noted for blazing the way in pioneer naval work, set afloat two ships of the then unprecedented size of about 16,000 tons, which carried no armor other than a heavy protected deck and an armored ammunition tube leading to heavily armored redoubt, and which embodied the remarkable combination of the then high speed of 18 knots and an all-big gun battery of four 17-inch guns, each weighing 105 tons. No one will deny that here was the prototype of our modern Indomitables and Goebens.

At the same time Great Britain possessed heavily armored battleships carrying each two 110-ton 16¼-inch guns. France was represented by the "Admiral Baudin," which mounted three 14.5-inch guns. Germany had scarcely begun the construction of her modern navy, nor had we in the decade from 1880 to 1890. Italy in 1888 discarded her 105-ton guns and armed the "Re Umberto" with four 13.5-inch, 67-ton guns. This piece, like all the earlier guns of the Italian navy, was of British make, and in 1893, the "Royal Sovereign" class was armed with four guns of the same caliber and weight. In 1891 Germany started her battleship fleet with the "Brandenburg" class, which were armed with four 11-inch guns, while the United States brought out the first three of its battleships, the "Oregon" class, which were armed with four 13-inch, 35-caliber guns.

In the British navy the 13.5 caliber gun continued to be the principal weapon until the appearance of the "Majestic" class in 1895, when the caliber was reduced to 12 inches, the ships of that class carrying four 35-caliber guns of this caliber. For the next thirteen years, battleships of the British navy were armed exclusively with the 12-inch gun, which was increased in length to 40 calibers in 1903, 45 calibers in 1906, and 50 calibers in 1908.

The French navy adopted a 13.4-inch 42-caliber gun in 1891. In 1893 they armed the "Carnot" and following ships with a 12-inch, 45-caliber piece, and in 1904 they were still using the 12-inch gun, mounting it upon the "Justice" and sister ships. Their latest ships of the "Normandy" class, will carry twelve 13.4-inch guns mounted in three four-gun turrets. In the decade 1890 to 1900, the United States Navy favored the 13-inch gun, which was mounted in the "Oregon," the "Kearsarge" and the "Alabama" classes.

The 12-inch gun mounted first in the "Iowa," 1896, was reintroduced in the "Maine" class, and continued to be the principal weapon of our battleships until the appearance of the "New York" and "Texas," the length being gradually raised from 40 calibers in the "Maine" class to 45 in the "Connecticut" class and 50 calibers in the "Arkansas" and "Wyoming."

Germany's first ships of the "Brandenburg" class in 1891 carried, as we have seen, four 11-inch 40-caliber guns. The next two classes comprising ten ships, mounted no gun heavier than a 9.4-inch, of which each ship carried four. In 1904, in the "Deutschland" class the Germans returned to the 11-inch gun, and this piece formed the main armament of the "Nassau" class of 1908 and the "Helgoland" class of 1909, the caliber length being raised from 40 to 45 and in the last class to 50. Close secrecy is maintained regarding the armament of the German ships under construction, but it is believed that they will mount a new 15-inch Krupp piece of great power.

As matters now stand Great Britain is mounting on her latest dreadnought a 15-inch 45-caliber gun, Germany a 15-inch 50-caliber gun, the United States a 14-inch 45-caliber gun, Italy a 15-inch 45-caliber gun, and France a 13.4-inch 45-caliber gun.

Although none of these weapons except possibly the German piece reaches the great weight of the 16¼-inch 110-ton gun of the "Italia," their striking energy is vastly greater. In flatness of trajectory, in the extent of the danger zone, and in the rapidity of fire they are immeasurably superior to the great gun of twenty-five to thirty years ago.

Sir William Preece

IT is a fortunate thing for this world that many of its great men of genius are gifted with a physique that preserves them to a ripe old age. This is not the time and place to discuss the reasons for this observed fact; we mention it only because it is once more brought into prominence by the decease, at the age of eighty years, of a pioneer of applied science, Sir William Preece.

A man of science may render services to the community in two ways—either by advancing our knowledge of and control over the forces of nature, or by directing, in administrative capacity, the work of others in developing scientific and industrial enterprises.

Sir William Preece has ministered to the world's needs not by one or the other of these two avenues, but by both. As an investigator he was one of the first to turn his attention to the possibility of transmitting electric signals to a distance, without the aid of wires. In 1893, two years previous to Marconi's epoch-making contribution to the art of wireless telegraphy, he successfully signaled to a distance of over three miles by electric induction, i. e., without the use of a wire connection between the sending and receiving station.

To Sir William Preece are also due important improvements in the field of multiplex telegraphy by wire and in railway block signaling. He is said to have introduced the electric bell for domestic services in England, and to have been the second man in his country to employ electric lighting in his home.

His administrative work was divided into two periods. The first sixteen years were spent in the employ of the Electric Telegraph Company, which was dissolved in 1870, its functions being taken over by the Crown. In consequence of this Sir William, then Mr. Preece, entered the Post Office service, in which he remained for twenty-seven years.

Sir William Preece visited the United States several times, bringing over with him some of his innovations in the field of telegraphy. His expressions of regard for our nation and his appreciation of some of those characteristics of which we are justly proud, give him a special place in the memory of the American people.

Cucaracha Slide Still Troublesome.—The loose and muck-like character of the material of which the Cucaracha slide is composed is giving considerable trouble to the excavators in their endeavor to open a way through the slide, in order to permit the water to flow by and allow the level of Gatun Lake to extend right through to Pedro Miguel locks. Blasting affects the material but little, the stuff immediately after a blast flowing in to fill the hole made by the dynamite. Sluicing seems to be the only effective way of opening up a channel, though even under the action of water, flowing under a considerable head, the cutting action is quite slow. On Wednesday, October 22nd, Gatun Lake level on the north side of the slide stood at 70.80 feet above sea level, while on the south side it had risen to only 52.81.

Engineering

Annual Speed Test of Our Destroyers.—In the recent annual speed test of the torpedo-boat destroyers in commission, the third and fourth groups, including ten vessels, made good speed, the "Jouett" exceeding her contract speed by averaging 32.9 on a two hours' run. All of these boats are oil burners. The "Beale" scored 100 per cent in a smoke test trial, running four hours with absolutely no smoke showing at the smokestacks.

The Largest Drydock.—The Canadian government is about to build on the St. Lawrence, near Levis, Quebec, a drydock which will be the largest in existence. Its dimensions will be as follows: Length, 1,160 feet; width of entrance, 120 feet; depth of sill at ordinary high water, 40 feet. It will be divided into two sections of 660 and 500 feet. The outer entrance will be closed by a steel rolling caisson, and the inner entrance by a floating caisson.

South Boston Drydock.—The Atlantic coast of America is shortly to have the advantage of at least two drydocks capable of receiving the largest steamers. In addition to the one to be built near Quebec, another of about equal size is to be built at South Boston. The dock is to cost $3,000,000, and a contract has been entered into by which the International Mercantile Marine, the Cunard, and the Hamburg-American lines will pay $50,000 a year for twenty years for its use.

American Sanitation in South Africa.—Great interest is felt by Americans in the visit of Col. Gorgas to South Africa to study conditions at the Consolidated Mines of the Rand at Johannesburg. The mining companies have requested Col. Gorgas and Major Noble, both of the Medical Corps of the United States Army, to make investigations and recommendations regarding the sanitation of this mining district, where about 200,000 men are employed.

Rapid Increase in Dreadnoughts.—In view of the fact that only eight years have passed since Britain laid down her first dreadnought, it will surprise many of the naval enthusiasts to know that, by the end of this year, the approximate number of dreadnoughts in the world, built or building, will be one hundred and fifty. The rate of increase, as given by an expert writer in the *Sph re*, is as follows: One in 1905, nine in 1906, twenty-four in 1907, thirty-two in 1908, fifty-two in 1909, seventy-four in 1910, ninety-seven in 1911, 125 in 1912, and 150 in 1913.

Profits from the New Dual Subway.—Under the new operating contract with the city, the earnings of all the Brooklyn elevated lines and the Center Street loop are pooled. From the gross earnings, the company deducts rentals, taxes, operating expenses, depreciation, and a certain amount paid the company in lieu of the profit it derived from its existing lines when the contract was made with the city. After these deductions, the surplus is devoted to interest and sinking fund charges upon the city's investment. For the first month of operation of the Center Street loop under the contract arrangement, there was a balance in favor of the city of $22,870.96, which was more than enough to pay the interest on the city's investment and within $2,814.52 of the sinking fund as well.

British Battleship as a Target.—The battleship "Empress of India," which was built at about the same time as our "Oregon," "Indiana" and "Massachusetts," has been set aside by the British Admiralty as a target for practice at long range with heavy guns. It is suggested by our contemporary, *Army and Navy Journal*, that we should use one of our old battleships built at the same time as the "Empress of India," as a target. We believe that the annual lesson that will be learned from pitting our 12- and 14-inch guns against the armor of one of these old ships would be of far greater value to the Navy than the ship itself. We learned much from the gun fire against the "San Marcos"; but her armor does not compare with that of the "Indiana" class, which is 18 inches in thickness and face-hardened by the Harvey process.

Strength of Steel Cars.—The report of the Committee on Car Construction, presented at the annual meeting of the Master Car Builders' Association at Atlantic City, recommends that existing steel or steel-underframe cars which have less than a certain strength must be classified with wooden cars, and be subjected to the same rules for combination defects. The standard of strength should be as follows: 1. Area of center sill should be not less than 16 square inches. 2. The ratio of stress to end strain should be not more than 0.09. 3. The length of center or draft sill members, or parts of members between braces, to be not more than 20*d*, where *d* is the depth of the member, measured in the direction in which buckling might take place. For new cars the area of center sill should be not less than 24 square inches, the ratio of stress to end strain not more than 0.06, and the length of center or draft sill members or parts of members between braces should be as stated above.

Science

A New Source of Guano is the coast of French Somaliland. The guano is shipped to Europe through the port of Jibuti, and is said to be of high quality.

Payer's Expedition to Franz Josef Land, which sailed from France August 10th, has not, according to the *Geographische Zeitschrift*, attempted to proceed directly to its objective point, but is to winter at Vardo, Norway, and proceed northward early next summer.

Prince Galitzin, the well-known seismologist, has been appointed director of the National Physical Observatory at St. Petersburg—i.e., director of the meteorological service of the Russian Empire—succeeding Gen. Rykatcheff, retired.

Cocose is the name of a French product manufactured from copra, probably with the addition of small quantities of other substances, which is gaining great popularity among Mohammedans and Hindus for use as a butter. Its peculiar recommendation, as compared with other butter substitutes, is that it contains no trace of hog fat or beef tallow, and hence does no violence to religious ideas.

American Ginseng, the market for which is almost exclusively confined to China and Korea, has been an article of export from this country for more than a century, the prices rising, as the wild supply diminished because of the clearing away of suitable forests, from 40 cents a pound in the early years of its collection to more than $6 a pound for the best qualities during the last eight years. The cultivation of the plant is comparatively recent; it began in an experimental way about 15 years ago, and has now attained such proportions that the output of the cultivated roots almost equals that of the wild. The total exports exceed a value of a million dollars a year.

Award of Hodgins Prize for Essay "On the Relation of Atmospheric Air to Tuberculosis."—On the recommendation of the Committee on the Award of the Hodgins Prize of $1,500 for the best treatise "On the Relation of Atmospheric Air to Tuberculosis," which was offered by the Smithsonian Institution in connection with the International Congress on Tuberculosis held in Washington in 1908, the Institution announces that the prize has been equally divided between Dr. Guy Hinsdale of Hot Springs, Va., for his paper on "Tuberculosis in Relation to Atmospheric Air," and Dr. S. Adolphus Knopf of New York city, for his treatise "On the Relation of Atmospheric Air to Tuberculosis."

Pure Atmosphere in Industrial Work Rooms.—It is a favorable sign of our time that there is an increasing tendency among manufacturers to install equipment to raise the sanitary standards in the working rooms of factories. Industries in which various forms of dust are scattered through the atmosphere of the working rooms are particularly in need of attention in this respect, and the matter is especially grave if the material floating in the open air is of poisonous character. How the problem has been solved in the white lead plant of the National Lead Company was described in the issue of our SUPPLEMENT for July 19th. A special system of ventilation and covered hoods protects the workman from the injurious effects of the lead dust which would otherwise contaminate the atmosphere.

Capt. Sedov's Russian North Polar Expedition, concerning the fate of which much anxiety had been felt since the autumn of 1912, when the last definite news of it was received, is now reported to be safe, for the time being, in the Pancratius Islands, just off the northwest coast of Nova Zembla. This information was brought by several members of the expedition, who were recently compelled by ill-health to return to Russia. The name of the expedition ship has been changed from "St. Phocas" to "Michael Souvorine." Sedov still intends to proceed to Franz Josef Land and to make that land his base for an attempted sledge journey to the pole. When raising funds for his expedition (a task in which he was powerfully aided by the great Russian newspaper the *Novoya Vremya*) Sedov appealed to the patriotism of the Russian people by announcing that he would name any important land he might discover "Nicholas II Land." He has, however, been anticipated by Commander Wilkitsky, who gave this name to the land he discovered last summer north of Cape Chelyuskin. Capt. Sedov's name, by the way, has been variously spelled in English and American journals—Seedow, Sedof, Sedoff, etc. The transliteration of Russian names is still, unfortunately, a matter of go as you please, and endless confusion results in indexes, catalogues, etc., where various entries of the same name are likely to be scattered through the alphabet on account of their various spellings. The hero of the latest Russian exploit in the Arctic is now known to the public as Wilkitsky, but in library catalogues in this country his name will generally be written "Vilkitskii." The SCIENTIFIC AMERICAN ordinarily adopts whichever spelling of a Russian name is in commonest use in English, without regard to a consistent system of transliteration, as the latter would often merely result in the mystification of the average reader.

Automobile

Folding the Automobile Top Into a Covered Receptacle.—Patent No. 1,071,348 to Richard H. Rice of Lynn, Mass., provides an automobile body with a receptacle in rear of the back seat, whose cover can be opened to permit the top of the automobile to be collapsed into the receptacle and then closed to enclose the top.

An Automobile Journey Across Africa, from south to north, has been undertaken by an English officer, Lieut. Kelsey, who started from Cape Town August 17th, and hoped to reach Alexandria, Egypt, in 120 days. The first crossing of Africa by automobile from east to west—viz., from German East Africa to German Southwest Africa—was accomplished by a German, Lieut. Graetz, as recorded a few months ago in these columns.

The Poor Man's Automobile.—England is said to have more than a hundred cycle car factories and it is no exaggeration to predict that America will soon vie with England in this line, even as it now exceeds all Europe in the production of the cheap automobile. One manufacturer, however, has gone in for the production of a small car which is decidedly not a cycle car, but a regulation automobile with full width tread, change gear transmission, four cylinder motor and full width seat. This little car, which will sell for less than $500, has a 90 inch wheel base and a 2¾ x4 inch motor developing about 22 horse-power. Under tests on the road the car has gained a speed of 52 miles per hour.

Petroleum Society Incorporated.—With the object in view of benefiting and uniting many unrelated interests that depend to a certain extent upon the production of petroleum, the American Petroleum Society has been organized at Pittsburgh, Pa., and incorporated under the laws of that State. It is intended to make a thorough study of petroleum technology, to circulate the information gained thereby and to conserve the petroleum resources of America. That much promise for relief from the present fuel situation in the automobile field is hoped for, is shown by the fact that the Society of Automobile Engineers, the American Automobile Association, American Society of Mechanical Engineers, the Society for Testing Materials, and several others sent delegates to the recent conference.

An Ambulance Hospital.—The Queen of Bulgaria, who takes a great interest in the Red Cross service, has had built a special ambulance automobile at a German works, and it was used in the field during the war in the Balkans. The roomy body of the limousine type is arranged in two compartments, one on each side. On the right hand side are lodged two stretchers one above the other which can be run in by means of rollers through a back door. The other side has two seats for the aids and is also reached from the back, there being also two side doors. As the side door in the stretcher compartment can only be opened from the outside, it is impossible for patients to leave the ambulance unawares. Ground glass panes give sufficient light while preventing the interior from being seen from the outside. Dr. Paul Frank, a prominent Berlin medical official, designed the present ambulance.

French Official Tests of Motor Trucks.—What will rank as the greatest motor vehicle contest in the history of motordom has just closed in France, after more than a hundred vehicles had been subjected to an official test by the French War Office, over a period lasting forty days. The trials began July 1st and ended August 9th. They were participated in by ninety-eight manufacturers, most of whom entered more than one model. The trucks were divided into two groups, ordinary motor trucks and tractors hauling one or more trailers. The former were required to cover 1,585 miles and the latter 1,106 miles in nineteen days over a circuitous route, operating on gasoline, benzine or alcohol without changing carbureters. The purchaser of any truck which has successfully met the required conditions is granted a subsidy by the French government, with the agreement that the truck is always to be at the service of the War Department in case of emergency.

Automobile Roads in Egypt.—To the activity of Lord Kitchener is due the construction of a fine automobile route in Egypt between Cairo and Alexandria. The road is some 130 miles long and was practically finished some time ago. Although some of the intervening cities are already connected by roads, this is the only through route between these two cities, so that it will be much appreciated. It now appears that the Public Works Department is engaged on plans for a complete network of main routes to cover the whole of Egypt, and these will be in charge of the government while the secondary roads belong to local authorities. Outside of military use, the plan will be of great economic value to the country in opening up inaccessible districts. In other cases it will add to the facilities given by the Nile and by railroads, both for commerce and for touring. According to this, the day is not far distant when an automobile can make the trip from the port of Alexandria clear to the first cataract, or a distance of 600 miles.

The Khedive's State Train

A Benzol-Electric Train for the Governor of Egypt

By F. C. Coleman

TWO motor coaches (a saloon coach and a composite coach for the suite and attendants), each equipped with a benzol-electric set, have recently been supplied to serve as a state train for the Khedive of Egypt. The system of driving adopted differs from previous forms in the fact that each of the two coaches is equipped with a combustion engine, dynamo and electric motors, and the train can be controlled from either of the drivers' compartments at each end. The division of the machinery between the coaches possesses the following advantages: A better distribution of the weight is secured. When reversing the direction of travel, the pushing of the front coach by the rear coach is avoided; and it also becomes unnecessary to shunt the coaches. If a defect occurs in one of the combustion engines or electrical machines, the train can be propelled at a reduced speed by the set which remains intact. The train is intended to travel at a speed of 40 miles per hour on the level, and the total train weight without passengers is approximately 100 tons.

The construction of the train is illustrated herewith. Each coach is mounted on two two-axle trucks. The benzol-electric sets are mounted in the two trucks running at each end of the train, the four electric motors being placed in the center bogie trucks. The combustion engines are fixed to a special inner frame which is supported from the axles by springs, so that with the ordinary double spring suspension of the coach body from the axles, a triple spring suspension is obtained between the coach body and motor, thus eliminating all vibration. The engine trucks are placed so far in front of the coaches that the engines and auxiliary machinery are completely exposed when the bonnets are removed; the electrical machines are accessible through openings in the floor. The radiators are mounted on the roof above the two drivers' compartments, and the connecting pipes between the engine and radiator and the exhaust are contained in a chimney in the front of each coach.

The saloon coach contains one large reception saloon and a private saloon, both of which are luxuriously fitted up. It also contains a lavatory, observation platform and driver's compartment. The composite coach contains two second class compartments, three third class compartments, a baggage compartment, a lavatory and a corridor leading through the whole coach to the driver's compartment. The two coaches have a vestibule connection with each other.

Each machine set consists of a combustion engine with its auxiliaries, and the electric generator and exciter, the latter machines being coupled to the motor by a flexible leather belt coupling. The four-cylinder combustion engine has a continuous output of 120 horse-power at a speed of 700 revolutions per minute. It will operate either with benzol or gasoline. The valves are all situated on one side and are actuated by a common shaft. The engine is started by means of compressed air from an air tank. The cooling of the engine is effected by water circulated through a honey-comb radiator, mounted on the roof of the coach, and in addition to the natural draft when traveling it is cooled by an electrically driven fan with a vertical shaft mounted on the coach roof. The fuel tank is suspended from the engine truck and the fuel is kept under the pressure of a neutral gas, nitrogen or carbonic acid, which is drawn from a steel cylinder through a pressure reducing device. This arrangement insures absolute immunity from explosion. The speed is regulated by a centrifugal governor. The regulator has a speed adjusting device operated electrically from the controller in the "out" position, by means of which the speed of the combustion engine can be reduced to approximately one third, when the coach is stationary. By these means the noise caused by the motors when the train is not moving is appreciably reduced and, moreover, there is a considerable saving of fuel. The exhaust gases are led over the roof into the open air through a silencer suspended in the chimney by springs and flexibly connected with the motor.

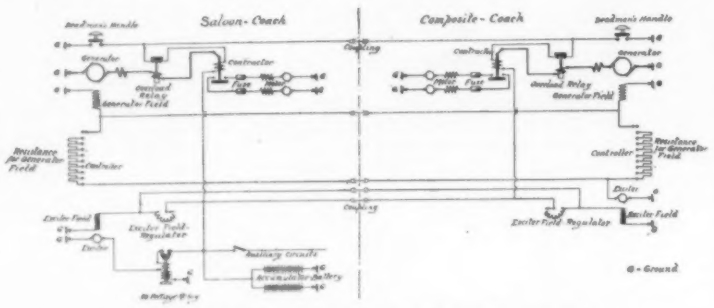
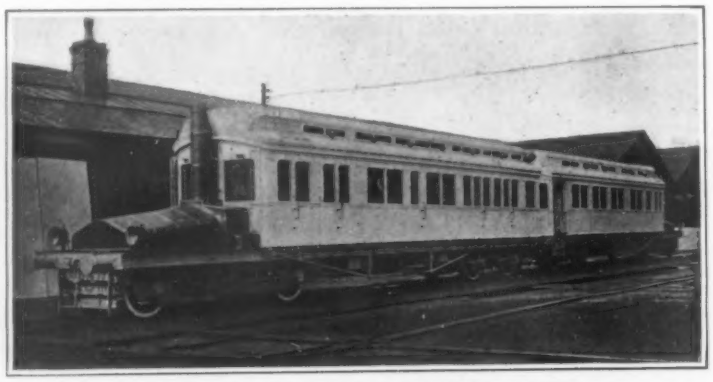
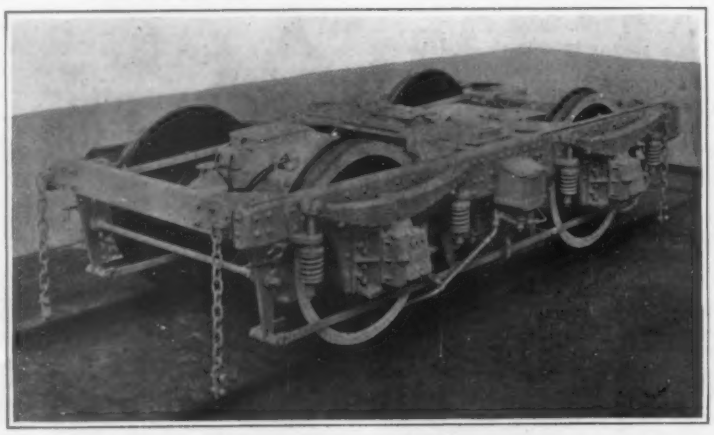


Diagram showing the system of electric connections.



Benzol-electric train built for the Khedive of Egypt.

Truck supporting the benzol motor and electric generator.



Driving truck fitted with two motors.

The generator in each machine set has an hourly rating of 80 kilowatts and a continuous rating of 50 kilowatts, the exciter having a continuous rating of 3.5 kilowatts. Both machines are cooled by a fan mounted on the same shaft. The normal generator pressure is 300 volts, the exciter pressure being 60 volts. The generator has auxiliary poles and can be overloaded at starting with a current up to 500 amperes. Each coach is equipped with two series wound auxiliary pole motors, each having an hourly rating of 80 horse-power at 300 volts. The motors work the axles through gearing, having a ratio of 1 to 2.6. The control is effected by regulating the voltage of the generators. The control of both generators may be carried out in common from either of the drivers' compartments. The system of connection is shown in the drawing. The motor circuits in both coaches are completely separate from each other, and the generator of one coach only feeds the two motors of the same coach so that heavy cable couplings are not required. There are the necessary safety precautions, such as fuses, overload release, and arrangements for breaking the circuit on releasing a push button on the controller. The reversers operated from the master controller are placed in each coach for reversing the direction of travel. In the field circuit, the one exciter excites the two generator fields connected in parallel, through a common resistance, the steps of which are gradually short-circuited by the controller at starting. As may be seen from the diagram, one of these resistances is placed in each coach, i. e., one for each controller, so that only one of them is in use for each direction. The two exciter fields connected in parallel are fed in a similar manner from an auxiliary battery with a one hour capacity of 68 ampere hours at 66 volts, to which the second exciter is connected in parallel. When the combustion engine is running at a low speed this exciter will be switched out automatically by a special switch, and when the speed is high it is switched in again, so that in the first case the battery works alone, and in the second case it works in parallel with the exciter, and can also be charged from the latter while the train is running. The lighting, signaling apparatus (consisting of a motor siren and gong) the battery ignition and other auxiliary apparatus are connected to the battery.

The operation of the controlling gear is as simple as in the case of a single coach, after the two benzol engines have been started up and the constant exciter voltage adjusted. Should any part of the equipment develop a defect, the system of connections can be altered in such a manner that the train will operate with the equipment of the other coach alone, this alteration being effected by means of a throw-over switch, which is sealed in its normal position.

Subsoil water has been a somewhat neglected factor in agriculture, yet it is the reserve capital upon which the success of the crops depends in a dry season, as well as the source of brooks and rivers, with all their multifarious uses. Dr. W. J. McGee of the United States Bureau of Soils has just published a monograph containing some rather startling facts based upon a "well census" of the United States; i. e., statistics relating to changes in water level in 28,906 wells. The amount of water within the first hundred feet from the ground surface in mainland United States is estimated as sufficient to form a reservoir conterminous with the country some 17 feet deep; i. e., an amount equivalent to 6 or 7 years' rainfall or some 20 years' discharge of all the rivers of the country. In order to be of use in agriculture (except as drawn upon in artificial irrigation) the upper level of this subterranean ocean must be within capillary reach of the surface soil. It is therefore alarming to find that this level is steadily sinking over the greater part of the country. In thirty-one States forming the half of the country best adapted by natural conditions to feeding and clothing the nation the average lowering since settlement seems to be no less than 9 feet. In some districts the lowering has averaged 3½ feet per decade.

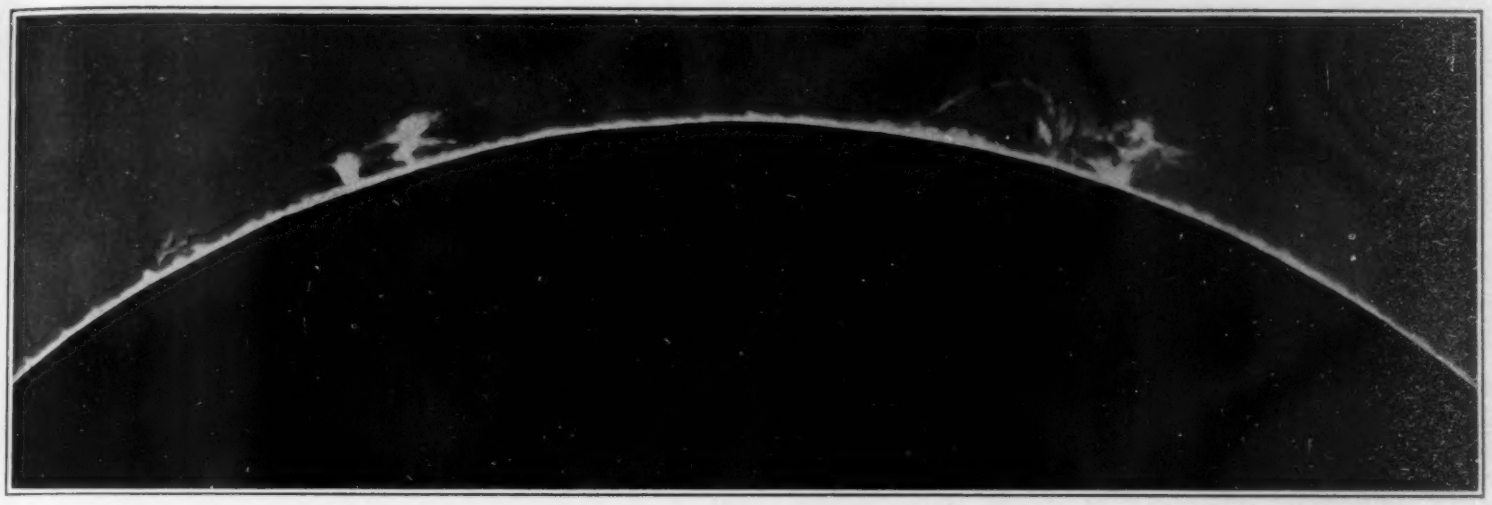


Plate I.—Showing typical conditions along the edge of the Sun. From a photograph made with a spectroheliograph using the light of calcium.

The Profile of the Sun

How Invisible Solar Prominences are Studied by Means of the Spectroheliograph

By Frederick Slocum of Yerkes Observatory

IF the sun is seen through fog or dust, or is observed through a smoked glass, its outline appears to be perfectly smooth and sharp. One would little suspect that its profile is really characterized by such fantastic shapes as are shown in the accompanying illustrations, which are from photographs by the author, made in the light of calcium with the Rumford spectroheliograph of the Yerkes Observatory.

Plate I shows typical conditions along the edge of the sun. The general ragged outline is the surface of the chromosphere. The larger forms are called solar prominences or protuberances.

Plate II illustrates different types of solar prominences.

Fig. 1 is a gaseous cloud resembling the appearance of a grove of banyan trees, rising to a height of 42,000 miles, and extending along the edge of the sun for a distance of 240,000 miles. Prominences of this type may persist for weeks or even months. This particular one was observed for 55 days.

Fig. 2 shows a group of prominences in the vicinity of a sun-spot. The streams of matter from both sides are pouring directly down into a sun-spot, which was very near the edge on that day. The arc of the sun shown in the picture represents a length of 300,000 miles, which will give some idea of the distance to which the attractive influence of a spot may extend.

Fig. 3 is a collection of arches and streamers, shown in fine detail. Its height is 63,000 miles.

Fig. 4 resembles somewhat a turkey standing 67,000 miles high. Another photograph taken two hours later shows what looks like a cloud of feathers floating off into space.

Figs. 5 and 6 are two photographs of the same prominence separated by an interval of 43 minutes. Within this time the prominence increased in height from 72,000 to 150,000 miles, corresponding to a movement of 30 miles a second. Such rapid transformations are characteristic of the so-called eruptive type of prominences.

Figs. 7 and 8 show the changes that took place in another prominence within 24 hours. Among other things, it may be noticed that the wind has apparently changed its direction. In fact, from prominences of this type some idea may be obtained of the general circulation of the solar atmosphere.

The existence of these prominences around the edge of the sun was first detected during total eclipses of the sun. When the moon passes directly in front of the sun and has cut off all of its light just up to the very edge, these forms may be seen projecting out beyond the edge, shining brilliantly with a rose-colored light. The only reason that prominences cannot be observed at any time by simply holding up a screen to cut off the direct light of the sun is that our atmosphere refracts and reflects the light of the sun, making the sky brighter than the prominences themselves. To an observer on the moon, which is devoid of atmosphere, the prominences, and even the stars by day, would appear against a black background of sky.

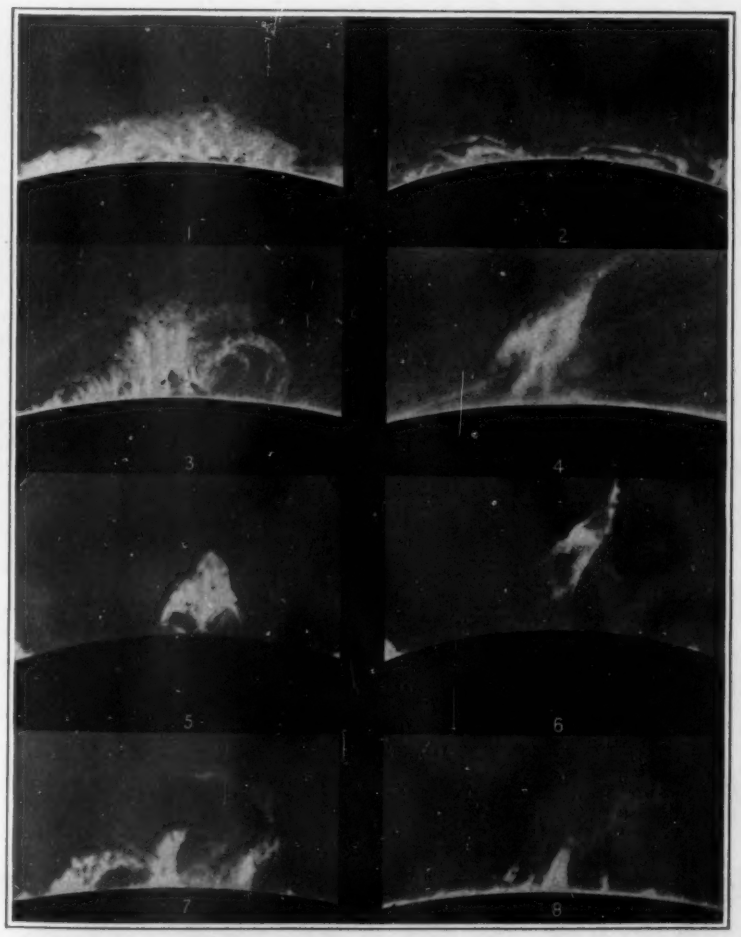


Plate II.—Showing eight different types of solar prominences; visible to the naked eye during total eclipses only, but detected by the spectroheliograph at all times.

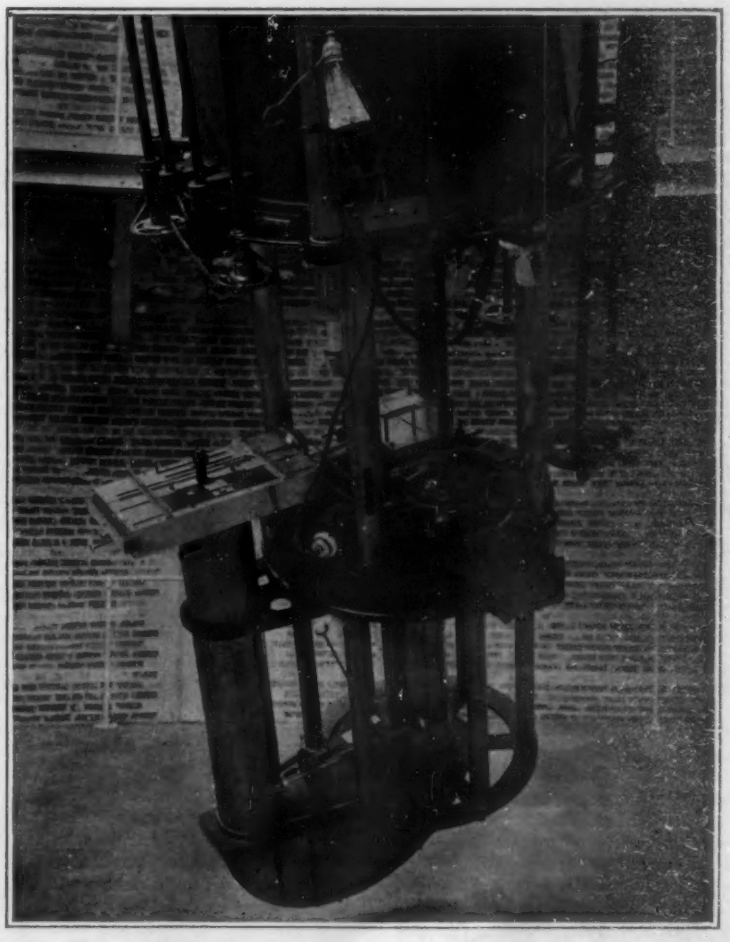


Plate III.—The Rumford spectroheliograph attached to the great telescope of the Yerkes observatory. The apparatus used for photographing solar prominences.

In 1868 Janssen and Lockyer discovered a method of reducing the glare of the sky without, at the same time, reducing the light of the prominences, thus rendering it possible to observe these solar appendages at any time, and not merely during the few minutes of a total eclipse.

It had been noted that the prominences gave a discontinuous or bright light spectrum. That is, if viewed through a spectroscope, a prominence would present several images of different colors, red, yellow, blue, etc., due to the light of hydrogen, helium and calcium, the chief constituent elements of the prominences. These images would be separated by appreciable intervals. If greater dispersion were used, that is, if a second prism were added, or a grating introduced, the distances between the various images would be increased, but their brightness would not be sensibly affected.

The light of the sky, on the other hand, gives an entirely different type of spectrum. It consists of fine dark lines projected against a continuous bright spectrum. If the dispersion is increased the total light is spread out over a greater area, and, therefore, the brightness of any one part is reduced. Moreover, the skylight gives dark lines exactly where the prominence gives bright lines. Thus, by using a spectroscope of sufficiently high dispersion, it is possible to see the prominences projected against a relatively dark background.

For all ordinary purposes the slit of a spectroscope is made very narrow, in order that the spectral lines may be fine and sharp, but for this purpose the slit may be open somewhat so that the whole of a small prominence, or a considerable portion of a large prominence, may be seen within the opening. If widened too much, the background becomes too bright, so, in the case of large prominences, it is necessary to study them in sections. For such observations the slit of the spectroscope is placed tangentially to the sun's edge, and, by rotating the spectroscope through 360 degrees, the whole circumference may be examined.

Ever since this method of observing prominences was discovered, daily observations of the sun's edge have been made in various places. In Italy a society was formed for this expressed purpose. Their publications, *Memorie della Società degli Spettroscopisti Italiani*, contain a practically continuous record of prominences for the past forty years. The published records are free hand sketches of the profile of the sun, showing the location and approximate form of all prominences for each day, and detailed drawings of those that were unusually large or active, to show the changes in form and size. At the same time, important but less systematic work of the same nature was being done in England, Austria, Germany and the United States.

From these visual observations, two distinct types of prominences were distinguished, the quiescent and the eruptive. These were observed to differ, not only in shape and activity, but also in composition and distribution. The quiescent prominences generally assume forms resembling clouds, or trees, or groups of trees. In size they vary greatly. Some attain the enormous height of several hundred thousand miles, while others are even less than a thousand. In lateral extent there is a corresponding difference. Some cover fifty degrees or more of the sun's circumference, while others may be confined within the limits of a single degree. In this type of prominences, as the name implies, the changes are comparatively slow, and yet at times there are remarkable exceptions to this rule. A prominence, which has remained quiescent for several days, may suddenly undergo some internal upheaval or explosion and be completely annihilated in a few minutes. The spectra of these prominences show that they are composed almost exclusively of hydrogen, helium and calcium. They are found in all latitudes, but a careful tabulation of the observations of many years shows principal maxima between 20 degrees and 25 degrees latitude in both hemispheres, corresponding roughly with the positions of maximum sun-spot frequency. The eleven-year period, manifested by sun-spots, is also shown, but to a less marked degree, by the quiescent prominences.

The eruptive type of prominences, on the other hand, is very closely associated with sun-spots. They are rarely found beyond the limits of the sun-spot zones, and they follow almost exactly the periodic frequency of sun-spots. They contain not only the hydrogen, helium and calcium of the quiescent type, but also frequently iron, magnesium, titanium, barium, sodium and many other substances, chiefly metals. The eruptive prominences appear as jets, rockets, fountains, etc. They are generally very bright and very active, sometimes undergoing complete transformations within a few minutes.

In 1891 dawned a new era in the study of prominences, when Prof. Hale discovered a method of photographing them. As in the case of visual observations, a spectroscope is used for this purpose, but when adapted to this special work it has been called by Prof. Hale a spectroheliograph. It differs from an ordinary spectroscope by having a slit in the focus of the camera, in addition to the ordinary slit in the focus of the collimator. The function of the second slit is to isolate any particular line of the spectrum, and enable the observer to make a photograph in the light of a single element. Thus, since prominences are composed chiefly of calcium, hydrogen and helium, it is possible to make a photograph of them in the light of any one of these elements. The *H* and *K* lines of calcium and the *C* line of hydrogen are best adapted to this purpose. The process consists of moving the image of the sun over the first slit, and at the same time, and at the same rate, moving the photographic plate across the second slit. The same result may be accomplished by keeping the image of the sun and the plate fixed and moving the slits. When photographing the profile of the sun, a metal disk is so placed as to cut off all light of the sun except that which comes from the very edge.

This method was used in taking the photographs from which the accompanying illustrations were made. Plate III shows the Rumford spectroheliograph attached to the great telescope of the Yerkes Observatory.

The Naval Airship

By Carl Dienstbach

AFTER aircraft had shown their efficacy as scouts for the army even under the test of actual war, the navies of the world immediately took steps to use them. But while the soldier had done much in turning the early toy aeroplanes into practical—albeit risky—machines, the sailor demanded an entirely novel sort of aircraft. Naval aeroplanes, because of the largeness of a naval theater of war, resulting from the fast movements of fleets, as compared to armies, and dependence on the shore, are of limited usefulness in escorting a fleet. An aerial vessel must leave shores far behind and cruise for days over the high seas. Only the mammoth dirigible, a type, the development of which would probably have been delayed by the enormous expense of experimenting, held out any promise of fulfilling such demands.

Germany is the one nation which has thus far built naval dirigibles worthy of the name. Two appalling disasters have shown how thorny is the path she had entered. But while the first seagoing dirigible of Germany, a 22,000 cubic meter craft, the largest the Zeppelin factory, noted as the only entirely successful constructors of sizes above 14,000 cubic meters, would undertake to build so late as a year ago, proved too small to withstand a real storm at sea (harder to avoid than on land in the absence of maritime weather stations), and while its more promising successor of 27,000 cubic meters fell victim to a totally unexpected internal catastrophe at the very outset of its career, there is no relaxing in Germany's efforts to make a dirigible practically the equal of a steamer. This attitude, in the face of losses in officers of the highest efficiency equivalent to the casualties of a small battle is more easily understood, if the inducements these experiments hold out, are analyzed.

At sea aerial scouting assumes an importance barely foreshadowed by the best that has been done on land. Owing to the level, uniform background it is impossible, barring fog or heavy rain, not to see a vessel from above at the remotest parts of the immense circle which extends to all sides for sixty-five miles even from the moderate height of 3,000 feet. It is easy to distinguish a warship from a merchantman, no matter how dimly seen. The characteristics are too pronounced. It is also fairly easy to recognize men-of-war of different nationalities. In that respect the United States have been most obliging to airships in adopting "naval landmarks" like floating Eiffel towers. But the difference between English tripods and German "castle towers" for military masts is also marked. Impressive, too, are the French smokestacks; but it is often sufficient to recognize vessels as fighting craft by the way the smoke drifts from a fleet, and then to call for the wireless countersign. Radio-telegraphy has led to ludicrous scenes in the Balkan war, when Greek and Turkish armorclads in action exchanged wireless epithets, quite as the heroes of Homer roundly swore at each other in the heat of battle.

Less unusual events may happen if a naval airship sights suspicious vessels from afar and an enemy tries to pose as a neutral before the aerial cross-examiner.

It is worth noting how much neutral war vessels may now influence the issue by their mere presence upon the scene. This may lead to new international regulations, such as secret countersigns for neutrals, etc. (On land the presence of neutral forces on a battlefield is obviously impossible.) It is not unlikely that a neutral who has posed as an enemy might be treated as an enemy. All this will be more clearly understood if we recall the more familiar conditions of aerial scouting over land, and ask: How would an army be treated who, without taking part in the fighting, would nevertheless decide the outcome by posing for the airscouts? In this aerial age neutral forces play involuntarily the part of the "neutral" Russians on the Prussian side under Frederick the Great.

The second important point which makes naval airscouting so superior to military airscouting depends on the mobility of fleets compared with soldiers. The potential possibilities of an enduring, staunch aerial vessel of sixty-five miles an hour, mounting strong and reliable wireless equipment that covers some 400 miles, are staggering. That is the craft which England really has to fear. Its mere existence is equal to doubling and trebling a foreign navy. Without such "eyes," the English fleet will either grope in the dark as a whole, or, being scattered to protect the shores, it will be defeated in detail by superior numbers. It will catch only an occasional glimpse of a foreign airship far away. But the enemy's fleet will be two hundred miles farther away, and always remain at that distance while safely convoying a numerous fleet of swift giant ocean liners crammed with soldiers to the "impregnable" shore. It is a very simple game of blind man's buff. Aeroplanes are not equal to this strategy. A condition *sine qua non*, eventually, will be that aircraft can not only "cruise" over water for several days, but have also enough lifting power or size to carry the ponderous gyroscopic compass and magnetic instruments with which to ascertain their locality, and consequently that of the enemy's fleet at all times and under any conditions. A good battery of long range automatic guns and machine rifles for aeroplane defense will also be required.

In this respect and others it might be pointed out that under modern conditions Britain's real danger zone has probably shifted from the Channel to Scotland, and that not the near, but the far foreign bases, which permit of an unobserved initial movement and a wide scope of action of the enemy's fleet, are now the formidable ones. Will this lead to many drownings of English aviators attempting to cross the German Ocean to Denmark and back without landing and to a permanent "peaceful" blockade of the German bases by the whole English navy? Need Germany submit to such a blockade just outside its home waters? Germany in turn is handicapped by the confined nature of the waters near its bases; but its own navy might be cruising in the open, protected by aerial eyes, before the beginning of hostilities. To start transports in safety would be more difficult, but a fleet of swift transports might also manage to cruise early in the open under aerial protection. They could rendezvous from anywhere, the airships "herding" them by wireless. The whole coast from Emden to the Danish border would furnish suitable points for a stealthy embarkation, with the help of strategical railroads. Once out of the North Sea the whole force would be absolutely safe as long as the airships held out. And there is no reason why a dirigible might not take aboard supplies from a vessel at sea.

Waste From Desks Goes Into Brushes

WASTE wood in the manufacture of school desks is now being used for the backs of cheap brushes, according to the statement of the forest service.

A large manufacturer of school desks in Michigan had a considerable amount of waste material in sizes which were too short to enter into the manufacture of the smallest desks, and could not be utilized further with his machinery or in his line of work. This material was all hard maple in pieces an inch thick, a foot or so long, and about three inches wide; for a long time it had been consigned to the waste pile and sold as firewood. This waste amounted to from one thousand to fifteen hundred board feet each day. A nearby manufacturer was using practically this quantity of maple, which he was sawing up into small pieces for making the backs of cheap brushes.

Members of the forest service, investigating methods of eliminating factory waste, conceived the idea that the blocks used by the brush factory could be readily secured from the waste of the school desk manufacturer, and on this basis got the two together. Arrangements were made so that the brush manufacturer now places orders with the other firm for its raw material and what was formerly waste is now a source of profit.

Moving Picture Records of the Balkan War

ONE of the good uses for moving picture films is for recording historic events. Not long ago the King of Roumania organized the production of a film of no less than 3,000 yards length, this being a reproduction of the Roumanian-Russo-Turkish war which determined the independence of that country. The film will then be kept in the archives of the realm. In order to carry this out, the army lent 8,000 men in uniform with arms and baggage, led by the officers. Another case is that of the Italian government, which is collecting all the films taken during the war in Tripoli. In England the same is done for the films of the King's coronation events.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Plea for Careful Maintenance of Aeroplanes

To the Editor of the SCIENTIFIC AMERICAN:

The recent sad fatality to Max T. Lillie, the Chicago aviator, at Galesburg, Ill., prompts me to present a few facts to the general public pertaining to the accident.

That the accident was not caused by motor stoppage, and not due to sudden gusts, is not generally known among laymen, who have learned the details only from the none too accurate press. It is only the real student of aeronautics who, after investigation, knows the true facts of the deplorable tragedy and its real bearing upon aviation.

The striking feature to be considered is, that the accident was entirely avoidable! A report preceded by a close investigation by Grover C. Loening, engineer of the Wright Company, states that the condition of the machine was one of "outrageous neglect." The machine was old, weather beaten, and *rotten*. Many necessary parts had been forgotten or neglectfully omitted in the setting up of the plane, and many of the vital steel parts were rusted so that loose-play joints were bound. The wings were old and the cloth had rotted until it was a mere rag, torn at the slightest provocation. The spars were rotten in many places and absolutely unfit to undergo bending stress, having entirely no pretense at strength. Is it to be wondered that the stress of a steep bank or a sudden dip should wrench a machine, neglected as this one was, asunder?

Naturally, aviation as a science is the innocent sufferer of this preventable accident, both in the loss of one of its best loved and foremost airmen and in the prejudice of the criticising public. The lesson of this tragedy is a plea for "greater care." If a steel part becomes rusty, it should be replaced. If the varnish is scraped from a spar, its needs should be attended to at once. Do not wait for an accident, perhaps fatal, to accentuate the faults of the machine! Discover the weak points and remedy them accordingly. Overconfidence in his machine has been the Waterloo of many an airman. By the adoption of "greater care" many accidents can be avoided, and aviation will profit thereby.

EVERETT P. GORDON.

Derry, N. H.

The Velocity of Hertzian Waves

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 2nd I read with interest of the proposed co-operation between the wireless stations at the Eiffel Tower and at Arlington to determine the velocity of the Hertzian waves. The writer expresses a doubt, which seems to me well founded, as to the possibility of devising means to "flash back" the waves across the Atlantic in order to measure their rate of transmission.

It seems to me, however, that other means could be devised which would accomplish the same end without calling for apparatus of such prodigious nicety of adjustment as that suggested. Would it not be perfectly practicable to proceed as follows: Let the wireless transmitters at Washington and at Paris be coupled as usual to the clocks so as to send out instantaneous signals each second, only let the clock at Paris beat seconds one tenth of a second or so behind that at Washington. If now a recording apparatus with revolving drum be installed at each station, the two ticks could be compared on the same sheet, at each end. It would of course be necessary to protect the receivers from the direct action of the nearby sending station, but that could readily be done by automatically switching off part or all of the antenna, and shielding what remained.

The record made on the revolving drum at Paris would show two ticks approximately one tenth of a second apart. But the lead of the Washington tick would be diminished by the length of time it took for the waves to cross the ocean; while at Washington the lag of the Paris tick would be increased by the same amount. Thus, if the ticks for any given second were compared on the two records, there would always be a difference equal to twice the time required for the waves to cross the intervening space. As any irregularities of the clocks would affect both recorders alike, it is evident that this difference would be independent of all instrumental errors, unless there were a difference in the "reaction time" of the two recorders. It would seem a rather simple matter, by interchange of instruments, to eliminate this error also.

The same process repeated over land somewhere would yield valuable information as to the effect of land and water on the waves. The distance measured could easily be reduced, if a drum revolving several thousand or even a few hundred times per second be indeed feasible.

HENRY H. RIGGS.

American Mission, Harpoot, Turkey.

Indian Summer at Home and Abroad

THE English meteorologist Abercromby introduced into the science of weather the important generalization of "recurrence," under which term he brought together the numerous instances of the supposed tendency of certain types of weather to occur about the same time from year to year, independently of, and often in marked contrast to, the regular march of the seasons. Thus in western Europe a period of unseasonable cold is found to occur very frequently about May 9th to 14th; whence the days dedicated to Saints Mamertus, Pancratius and Servatius, May 11th, 12th, and 13th, are known in France and Germany as the "ice saints." In England a similar period occurring traditionally in the second week of April is called "blackthorn winter," while in America we have a "dogwood winter" some time in May—"when the dogwood is in bloom"—and it is a common belief that the snowball blossoms bring cool weather with them to justify their name.

In England rains are looked for about August 2nd to 8th. These are the "Lammas floods." New England has its "January thaw." Both the Old and New World cling firmly to the tradition of an "equinoctial storm."

The most famous case of recurrence, however, is the Indian summer—so called in America, but in Europe rejoicing in a score or more of other names. It is "all-hallow'n summer," "old women's summer," "go-summer," "All Saints' summer"—collectively—and well-nigh all the saints' summer individually, since in various lands it is linked with the names of Saints Luke, Martin, Michael, Bridget, Teresa, Wenceslaus, and so on, through half the autumnal calendar. The terminology is curiously confused with that of the spider-webs that float in the air in mild autumn weather—"gossamer," "go-summer," "goose-summer;" in German, "Altweibersommer," which means both the webs and the season of their occurrence, the two things being woven into the same fabric of folk-traditions.

The various cases of "recurrence" have been the subject of numerous investigations on the part of meteorologists. In Europe most attention has been paid to the alleged cold period in May—the "ice saints." Many long weather records seem to show that a cold spell does commonly occur in the middle of May, and it has been explained as follows: With the approach of summer the land warms much faster than the ocean; continental Europe becomes relatively hot, the air above it rises, reducing the barometric pressure, while relatively high pressure prevails over the cold ocean northwest of the British Isles. The surface winds then flow from the cold anti-cyclone toward the cyclone; in other words, cool northwest winds prevail over western Europe. A more searching study of the temperature records, however, has in recent years tended to discredit the existence of any well-defined cool period limited to particular days, or even weeks. It is evident that the belief in the "ice saints" having once taken root in the popular mind, the occurrence of a cool spell at almost any time in the spring would be readily accepted by unscientific people as confirming the phenomenon as one of regular recurrence; just as almost any autumnal storm is popularly identified as the "equinoctial," without much regard to the actual date of the equinox. Iconoclastic science long ago demolished the legend of "the" equinoctial storm. So far as eastern North America is concerned, the autumnal equinox falls within the period in which West Indian hurricanes are likely to sweep up the Atlantic seaboard. If the public chooses to call one of these tempests an "equinoctial," it is entirely at liberty to do so; the name being neither more nor less appropriate than that of "Easter lily" for a plant that blooms in the early and middle spring, but by no means exclusively on Easter Day.

"Indian summer" in America is quite as elastic a term as "equinoctial." As the name of a *type* of autumnal weather it has a pretty definite meaning. As implying the more or less regular recurrence of a particular season, year after year, at approximately the same date, it is misleading. One often hears people say, of a few days of fine, crisp autumn weather, "I wonder whether this is Indian summer?" To which another may answer, "No, it can't be, because we haven't yet had 'squaw winter.'" The idea so firmly rooted in the popular mind that each autumn, as a rule, there is *one* period of cold, cloudy weather—with perhaps a flurry of snow—followed by *one* period of mild, sunny, hazy days, finds no confirmation in the prosaic records of the meteorologists. Indian summer weather, in fact, prevails intermittently over a period of two or three months. Thoreau, at Concord, Massachusetts, notes in his "Autumn" that during the ten years from 1851 to 1860 weather of this type occurred on September 27th, October 7th, 13th, 14th, 31st, November 1st, 7th, 8th, 17th, 23rd, 25th, December 7th, 10th, and 13th. The indefiniteness of the term is even more strikingly brought out in Schaeffer's analysis of the weather records of Milwaukee, in the *Monthly Weather Review* for September, 1902. (The same journal for January and February, 1902, contains the fullest of all discussions of Indian summer from the philological rather than the meteorological point of view.)

The European equivalent of Indian summer is a trifle less indefinite. A painstaking memoir on this subject, from the pen of Dr. Artur Lehmann, has recently appeared in Germany.[1] Dr. Lehmann gives us, in the first place, an elaborate account of the terminology of the "after-summer," the commonest name for which in German is *Altweibersommer* ("old women's summer"). In a great many countries and districts this season is, as we have said above, traditionally associated with the day of a particular saint in the autumn calendar; thus implying a more definite time of occurrence than does the term "Indian summer." Dr. Lehmann gives the reputed dates for the beginning of the season, which vary considerably with latitude; thus Russia has a "young women's summer" as early as the latter part of August, while the "Estate di San Martino" of Italy begins November 11th. The author also gives us many interesting particulars concerning the association of the "after-summer" season with floating spider-webs, or gossamer; a theme of picturesque legendry.

A careful analysis of meteorological records shows that the occurrence of the Indian summer type of weather is most frequent over central Europe in the 55th pentad of the year; i. e., September 28th to October 2nd. It is easily traceable to the presence of a widespread area of high barometric pressure over the Continent, somewhat east of its center, bringing mild southeasterly winds to the region in question, and attended by clear skies and strong insolation during the day. These conditions may persist for only a few days, or, occasionally, as long as four weeks.

We must infer, however, from the facts presented in Dr. Lehmann's memoir, that, as in the case of our own Indian summer, the "after-summer" weather of Europe may occur intermittently through the autumn; but that the particular period of such weather that happens to coincide with various autumnal activities of the rural population is the only one that attracts general attention. From a meteorological point of view, in Europe as in America, there are probably several "Indian summers" in some years, while occasionally a year may have none. In other words, "Indian summer" is merely a convenient designation for the most delightful of all types of autumn weather.

First United States Patent on Ice Making

THE first United States patent for the manufacture of ice, No. 8,080, was granted to John Gorrie of New Orleans, La., on May 6th, 1851, for a process of artificial production of ice, and the original patent and papers are now on exhibition in the United States National Museum.

They are especially interesting in that they cover completely Dr. Gorrie's early method of making ice and his refrigeration system, which was the indirect process, that is, the cooling of an uncongealable liquid which in turn cooled other substances. According to the early custom of the Patent Office, the papers and the patent are written by hand on parchment, and though now quite old, are nevertheless in excellent condition.

In 1898 Mr. George H. Whiteside of Apalachicola, Florida, secured these papers which he presented to the Southern Ice Exchange, and for that organization deposited them in the National Museum, together with a series of articles on the same subject which appeared in the *Commercial Advertiser* of Apalachicola, Fla., in the year 1844, as written by Dr. John Gorrie under the *nom de plume* of Jenner.

The Current Supplement

ONCE again the plan of connecting England with the European continent is being agitated, with more promise of actual execution than ever before. An account of the latest project is given in this week's SUPPLEMENT.—Some tractors for farm service, exhibited and tested at the recent Soissons competition, are illustrated and described.—Dr. A. Gradenwitz writes on the manufacture of porcelain.—R. S. Whipple's paper on modern methods of temperature measurements is concluded in this issue.—E. D. Clark writes on the origin and significance of starch.—The elimination of cinders from furnace gases is an important industrial problem. How it has been successfully solved in a large plant is shown in an illustrated article.—F. E. Kaeppel describes dial scales for the rapid weighing of merchandise.

There are fifty-five oaks in the United States, about evenly divided between the East and the West. The eastern species and particularly white oaks are the most valuable.

[1] "Altweibersommer; die Wärmerückfälle des Herbstes in Mitteleuropa," Thiel's *Landwirtschaftliche Jahrbücher*, vol. 41, 1911, p. 57-129.

Fig. 1.—Microscope under bell glass, photographed with visible rays.

Photography By Invisible Light

Things We Should See if Our Eyes Were Sensitive to Ultra-violet and Infra-red Rays

By Prof. R. W. Wood, Johns Hopkins University

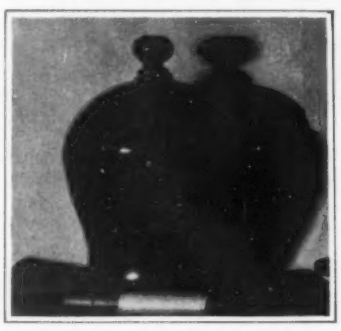


Fig. 2.—Same subject as in Fig. 1, photographed with ultra-violet rays.

DURING the past two years I have made from time to time experiments designed to show to what extent our knowledge of nature could be extended by making photographic observations of various phenomena by means of light invisible to the eye. It has been known for many years that these invisible rays exist, and their properties have been most exhaustively investigated, but up to the time at which these experiments were commenced no attempts had been made to utilize them as we make use of ordinary light for the study of objects. It is obvious that a great part of our knowledge comes from simple observation by the eye, unaided by any optical instruments; but the eye is sensitive only to a narrow range of the spectrum, for some of the rays that reach us from the sun and from our artificial lights make no impression upon the human retina. Now, inasmuch as these invisible rays are reflected from all objects in precisely the same way as are the rays of visible light, it seemed highly probable that if the range of sensitiveness of the eye could be extended so as to make use of these obscure rays, many new facts would immediately be revealed.

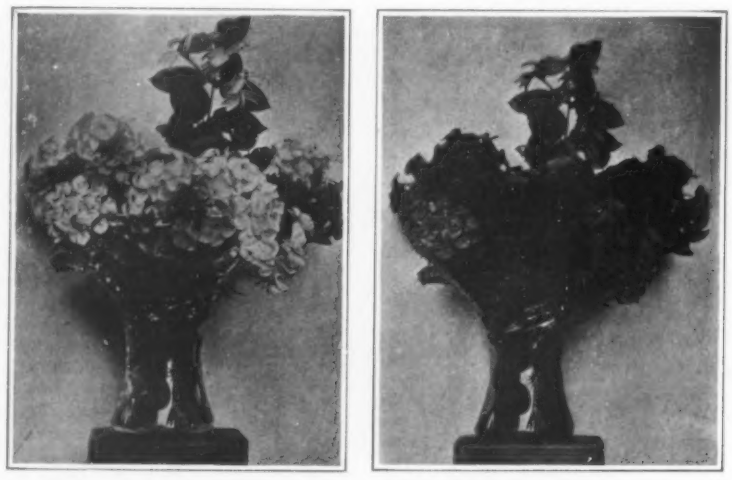


Fig. 3.—White phlox, white geranium and honeysuckle in glass vase, photographed with visible light (at the left) and ultra-violet light (at the right).

While this cannot be accomplished directly, we can, by the aid of photography, secure pictures which tell us how objects would appear if we could see them by means of invisible light. For example, I observed that letters painted in Chinese white on a sheet of white paper, while absolutely invisible to the eye, came out coal-black when photographed with the ultra-violet rays.

During the past two years I have so far succeeded in improving the method that it is now actually possible to photograph the metallic vapor that rises from a drop of quicksilver at the temperature of the room, though its presence in the air could hardly be detected by the most refined methods of chemical analysis. This savors almost of spirit-photography, experiments with the "aura," and such other fantastic fables of which we read, and I feel sure that there will be renewed appeals from the writers of the numerous letters I received shortly after the results of my first experiments were made public, urging me to devote my attention to the photography of the spirits of the departed by means of ultra-violet rays, for "hope springs eternal."

And now a word or two about the ultra-violet rays as an introduction to my subject. If a beam of sunlight is passed through a prism, a rain-bow band of colored light is thrown upon the wall; or, as we say, the prism has decomposed the white light into its elementary colors, forming a spectrum. If we receive this spectrum upon a photographic plate, we find that it is much longer than it appears, for there are rays beyond the violet that do not affect the eye, but that blacken the photographic plate; and the same is true in the region beyond the red, though to photograph these rays we require a specially sensitized plate. When we employ a prism cut from a crystal of quartz instead of glass, we find that the spectrum is still more extended in the ultra-violet region, the invisible portion being much longer than the visible. In other words, glass, which we are apt to regard as one of the most transparent of substances, is absolutely opaque to the shortest ultra-violet waves of light; and if we wish to make use of these rays in our work, we must employ a camera fitted with a lens of quartz, and must, in addition, prevent all rays of visible light from entering it. This is not an easy matter, for practically every substance that is opaque to visible light is still more opaque to the ultra-violet. To this there are however one or two exceptions. Some ten years ago I discovered that a certain aniline compound with a long name (nitroso-dimethyl-aniline), while opaque to the blue and violet actinic rays, was very transparent to the ultra-violet, and by combining this substance with other media, it was possible to prepare screens, or ray filters, as they are called, which transmitted only the invisible rays.

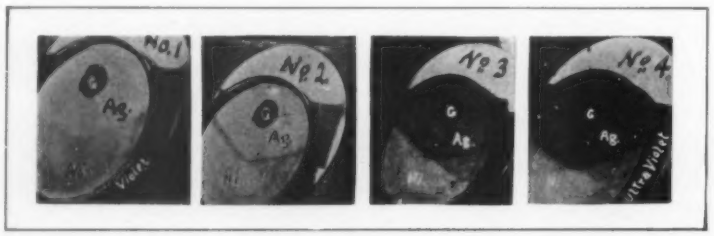


Fig. 4.—Photographs of reflectors, showing that nickel makes the best mirror for ultra-violet light.

These ultra-violet screens have been extensively used in investigations made with invisible rays, both in this country and abroad, and to a certain extent in astronomical photography. A more remarkable case, however, is that of a thin film of metallic silver deposited on a plate or lens of quartz. Such a combination is transparent only to the invisible ultra-violet rays, which are completely absorbed by glass; and by simply providing a camera with a lens of this description we can at once photograph objects as they would appear in ultra-violet light. We may use either sun-light or the light from one of the recently perfected mercury arc lamps made of fused quartz, the ultra-violet radiations of which are especially powerful.

Fig. 5.—Portion of the moon photographed with yellow, violet and ultra-violet light (left to right). Note the spot indicated by the arrow.

The complete opacity of glass to these rays is beautifully illustrated by the photographs reproduced in Figs. 1 and 2. The subject is a microscope, covered with a transparent glass bell-jar, standing in front of a sheet of white paper. The invisible rays used in this case came from a mercury arc in a quartz tube, and we see that the bell-jar is as opaque to them as if made of ebony. Only the two images of the mercury lamp reflected from the outer surface appear, the microscope having vanished; and the shadow is as black as if thrown by a metal ball.

If our eyes were sensitive only to the ultra-violet region, our houses would have to be provided with open windows, for glass, celluloid, and all our common transparent substances would let in no rays of light by which anything could be seen. How fortunate, we exclaim, that this mistake was not made; and yet it could not very well have been otherwise, for the materials out of which nature has developed our eyes are themselves opaque to the rays, and no evolutionary process could be expected to develop a retina sensitive to rays which never reach it. I have found that many, though by no means all, white objects appear black in ultra-violet light, as for example, common white garden flowers. This opens up the interesting question as to whether we have selective coloring in the invisible region of the spectrum, or, in other words, are all white flowers equally dark in ultra-violet light, or is the absorbing pigment different in different flowers, and are there variations of the spectrum region absorbed? These questions are answered by Fig. 3, where we find reproduced two photographs of a glass vase containing blossoms of white phlox and white geraniums and honeysuckle. The white petals of the honeysuckle and phlox come out dead black in the latter, while the geraniums are much lighter in tone. By employing a spectroscope I have found that the absorbing pigment is different in the two cases, so that we do in reality have selective coloring in this region, and we should be able to perceive color differences between various white blossoms, if our eyes were able to observe them by the obscure rays. The significance of these differences and the part, if any, they play in the economy of the plant are questions to be answered by the plant physiologists, and I prefer not to speculate about them.

Ultra-violet photography has already furnished new data in astronomy and astro-physics. Prof. Hartmann of Göttingen has recently photographed the great nebula in Orion through one of the ultra-violet screens which I described in 1901, and at the same time by visible light; and he has found that the shapes of the luminous gas masses composing the nebula are different in the two cases. In other words, the gas which radiates the ultra-violet light is distributed over regions not occupied by the gas which radiates visible

light. By applying the methods of modern color photography to the two pictures secured by Prof. Hartmann, I have made a very interesting composite color picture, showing the distribution of the two gases which form the nebula in a most striking manner.

Up to the present time my own investigations have been confined to the moon, as my instrumental equipment is not powerful enough or sufficiently well mounted to enable me to do much with the planets, though a few attempts have been made with Saturn.

It may seem strange that while we can ascertain the chemical substances present in the most distant stars, our ignorance regarding the constitution of our nearest neighbor, the moon, is absolute, so far as any direct evidence is concerned. There is every probability that it does not differ markedly in composition from the earth, but the spectroscope tells us nothing, for the moon is cold and shines by reflected light. Many terrestrial substances can however be recognized at once by mere inspection, without spectroscopic or chemical analysis. A mineralogist will walk with you through a museum and name almost every mineral on sight. In nine cases out of ten the color will be found to be one of the chief factors taken into account. But on the moon we find little or no trace of local color, even in the largest telescopes. If we saw patches of a yellowish brown color we should say, "probably iron oxide," while bright green spots would be ascribed to copper oxide, if permanent, and to vegetation perhaps, if they appeared and disappeared as the long lunar day changed to the lunar night. But we find nothing of the sort. In my earlier experiments, however, I noticed that a little black spot appeared close to one of the lunar craters in all the photographs taken with ultra-violet light, while no trace of it was visible in pictures made by yellow light, which represent about what we see with a visual telescope. This seemed very important, and I at once commenced experiments with a view of finding out, if possible, what the dark material might be. It was first necessary to get larger and better photographs, and accordingly I had made a concave reflector, sixteen inches in diameter with a focal length of twenty-six feet. It was useless to silver this mirror in the usual way, since a polished silver surface reflects only about four per cent of the ultra-violet rays with which the work was to be done. This is very nearly the reflecting power of ordinary glass for visible light. Nickel, however, behaves very much better in this region, reflecting about fifty per cent of the ultra-violet, though very inferior to silver as a reflector for visible light. This remarkable difference in the reflecting power of the two metals is well shown by the photographs reproduced in Fig. 4, which were made in the course of some preliminary experiments on a method of making astronomical reflecting telescopes suitable for ultra-violet work. The photographs are of a shallow glass dish, which was silvered on the inside by the chemical process used for coating telescope mirrors. This film of silver made the surface of the glass a conductor of electricity, and by dipping the lower portion in a bath of nickel sulphate a film of the metal was deposited by a battery, after which a small patch of the silver film that remained uncoated with nickel was removed from the glass by scraping the surface with a pen-knife. In the photographs the silvered part is marked *Ag*, the nickel *Ni*, and the patch of clear glass *G*. The dish was mounted near an open window in such a position as to reflect the light of the sky into the camera, and four photographs made of it, one by ordinary light and three by ultra-violet, using silver films of different thicknesses on the quartz lens, to cut off the visible rays. In number 1, made by violet light, we see that silver reflects much more powerfully than the nickel, while the patch of clear glass is almost black, owing to its very low reflecting power. In number 2, made by the mixture of violet and ultra-violet rays, which we utilize when we employ a thin film of silver as a ray filter, we find that the silver and the nickel have about the same reflecting power, while in numbers 3 and 4, taken by ultra-violet of increasing purity, we find that the silver reflects no better than the clear glass, appearing quite black. Nickel having thus shown itself to be a suitable metal, a method was worked out for depositing it on the large mirror, and the studying of the moon was resumed.

Fig. 6.—Volcanic tuff with invisible deposit of sulphur, photographed with yellow, violet and ultra-violet light.

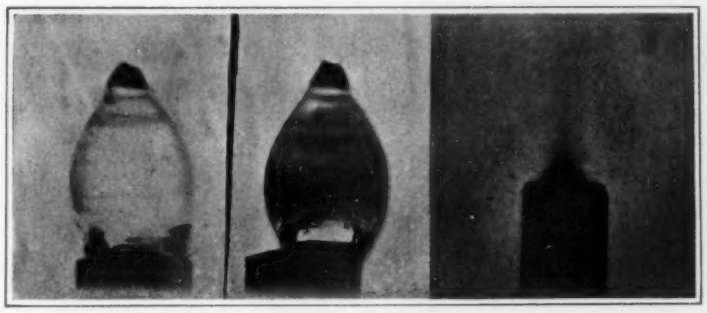


Fig. 7.—Photographs of mercury vapor made by ultra-violet light.

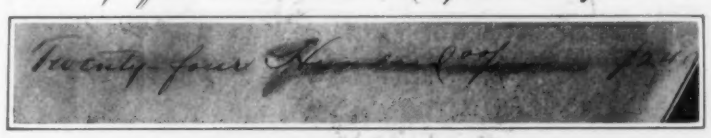


Fig. 8.—How a raised check can be detected by ultra-violet light.

Photographs of the full moon were made by light taken from three different regions of the spectrum, the yellow, violet, and ultra-violet; for it had occurred to me that it would be interesting to apply the method of three-color photography to the case. In the usual method of making color photographs, three negatives are made through color screens corresponding to the three primary colors, and the final color picture results from the superposition of three positives printed from them, each positive being stained with a primary color. In the present case, however, I employed ultra-violet light in making one of the three original negatives, and then built up the color-picture in the usual manner. The printing operations were done for me by Mr. Ives, the pioneer in work of this kind, and the result was a very beautiful transparent picture of the moon, in which the local differences in its reflecting power for the three regions of the spectrum utilized were strongly differentiated in color. In this picture the dark spot near the crater Aristarchus, about which I shall have more to say presently, came out bright blue, while some of the *maria* or gray spots came out reddish in tone, and others greenish, indicating differences in the mineral composition of these areas. As to the nature of the Aristarchus spot I have already reached a pretty definite conclusion. It is well shown in the ultra-violet photograph reproduced in Fig. 5. Referring to these three pictures of the same portions of the moon's surface, on which I have indicated the crater Aristarchus by an arrow, we see that in the picture taken by yellow light there is no trace of the dark spot; in the one taken by violet light it is just beginning to appear, whereas it is strongly developed in the one taken by ultra-violet. The question to be answered

(*Concluded on page 385.*)

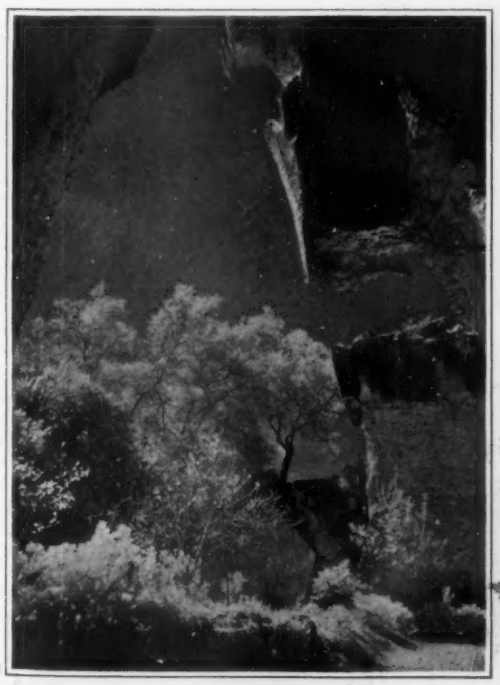


Fig. 9.—View at the bottom of the Latomia of Syracuse, Sicily.

Fig. 10.—A fine row of trees in the park of Florence. Note the absence of "atmosphere."

(Photographs made with infra-red light.)

Fig. 11.—Old gate and cypress trees just outside of Florence.

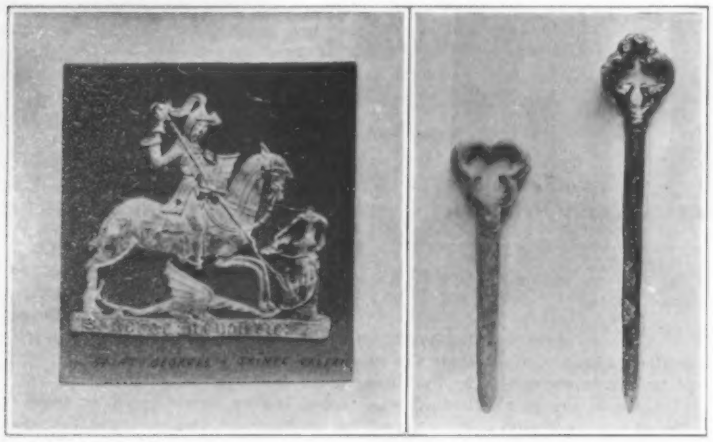


Fig. 1.—St. George and St. Valérie group and the shorter of the fourteenth century pencils are greatly deteriorated, while the larger one is preserved by a coating of varnish.

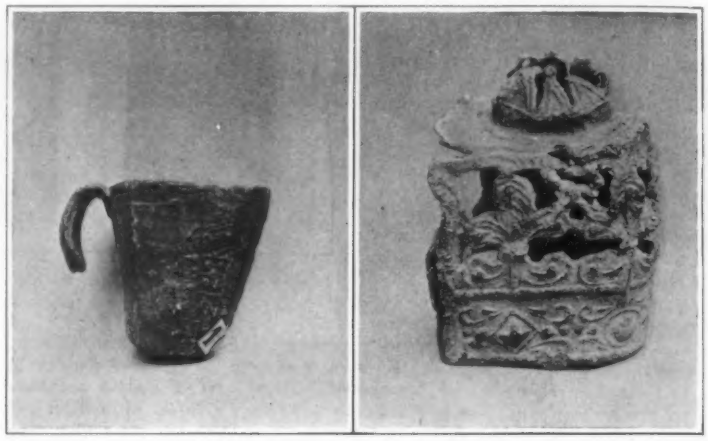


Fig. 2.—Shows a birds' drinking cup in perfect condition and a diseased and crumbling fifteenth century birds' feeding cup, which in time will fall into dust.

A Disease of Old Leaden Art Objects

How Corrosion may be Retarded by a Protective Coating

By Jacques Boyer

A FEW years since Prof. Cohen of the University of Utrecht showed that tin is subject to a disease which can be communicated by contact from one object to another. The experiments of the Dutch chemist proved that this disease of tin is a molecular transformation, in the course of which the white metal turns gray, increases in volume by one fourth, swells, disintegrates and finally falls off as an exceedingly fine powder.[1]

Prof. Camille Matignon of the College de France attributes to a disease of very different character the spontaneous and progressive destruction of old leaden seals, pendentives, brooches, drinking cups and feeding cups for birds, medals, pilgrims' badges and other art objects. The curator of the Musée de Cluny, having made the surprising discovery that some leaden articles in the collection were gradually becoming corroded and falling to dust, while others remained intact, submitted the matter to Prof. Matignon, who, analyzing the powder collected in several cabinets, found that it consisted chiefly of carbonate of lead, and gave the following explanation of the phenomenon.

Those leaden objects that are subject to the disease contain traces of chlorides which, by catalysis, render the metal susceptible at ordinary temperatures to the simultaneous action of the oxygen, humidity and carbon dioxide present in the atmosphere. The catalyzer then returns to its initial state, and the process is repeated indefinitely. This theory is confirmed by Prof. Matignon's detection of chlorides in the diseased specimens, and by his production of the disease in healthy specimens by artificially infecting them with chlorides.

Several cases of this curious metallic disease are illustrated in the accompanying photographs. Fig. 3 shows a Florentine medal of the sixteenth century, by Vittore Pisano. Behind the head (that of Alphonse d'Aragon) appears a white spot, which marks the commencement of the disease. Fig. 4 shows a well preserved pilgrim's badge of the twelfth century between two pilgrims' badges of the same period, which have become entirely white.

Fig. 2 shows a birds' drinking cup in perfect condition beside a birds' feeding cup of the fifteenth century, which is falling into dust. The group representing St. George and St. Valérie, in Fig. 1, is greatly deteriorated, and so is the shorter of the fourteenth century pencils, while the longer pencil has been protected from the disease by a coat of varnish.

The presence of chlorides in old leaden objects is easily explained. Many of these objects have been buried in the earth, and the varying proportion of chlorides found in different specimens is due to their longer or shorter sojourn in soil infiltrated with salt water. The sea salt probably causes the corrosion of the lead by forming an alkaline carbonate or bicarbonate which is afterward reconverted into chloride, or an oxychloride of lead may be formed. This hypothetical cycle requires an alkaline reaction for the intermediate products, and Prof. Matignon has detected alkalinity by depositing a drop of phthalein solution on the surface of a corroded sheet of lead.

As a remedy, the chemist recommends the application of a transparent celluloid varnish to leaden art objects. This protective coating retards the progress of the corrosion by excluding the air almost

Fig. 3.—A sixteenth century leaden medal, in the first stage of metal disease.

completely, but it does not entirely prevent deterioration.

Making Two Automobile Lamps Do the Work of Four

AMONG the more recent developments in the automobile field, it is interesting to note that side lamps—unmistakable evidences of the horse-drawn forbears of the modern horseless carriage—slowly but surely are disappearing; and though the development is a perfectly logical one, the combination of head lamps and side lamps as now practised by a number of prominent manufacturers still presents a number of knotty problems that have for the most part been only superficially solved in the rush to exploit the latest innovations demanded by the buying public.

When electricity as an illuminant for automobiles became suddenly—almost over night—such a potent factor of equipment and practically without exception was hastily adopted and advocated by manufacturers, the possibility of eliminating side lamps was quite overlooked—a fact which is all the more astonishing in view of the present day tendency toward the elimination of all that is not absolutely necessary for the proper operation of a car and for compliance with the laws regulating motor vehicle traffic. Now, however, light has broken in on designers and made clear that as far as the law is concerned, and also as far as the operation of a car is concerned, two lamps are all that are required, neglecting as outside the present question the rear lamp. But, needless to add, the necessity for combining in those two lamps the functions of four lamps also became apparent and the manner in which the problem has been attacked in not a few instances makes plain that there is room for much improvement.

In eliminating the side lamps, it is necessary to make provision in the head lamps for the production of considerably less light than ordinarily would be produced by full sized bulbs and the full pressure of the battery, and there are several ways in which this can be done. Probably the simplest way is to introduce a small rheostat into the circuit, but this method is open to the objection that the rheostat consumes current that might be put to some better purpose; it represents a needless waste of current, in other words.

Another method is to provide a switch with which the connections of the lamps, normally multiple when full candle-power is desired, can be changed to series temporarily. In this case the lamps would consume considerably less current when "turned down" than is normally consumed when operating at full brilliancy. This method, though better than the method involving the use of a rheostat, has the disadvantage that the failure of one lamp of necessity means the failure of both. Apparently, therefore, nothing remains but to make provision within the lamp for the reception of two bulbs—one of say 16 to 21 candle-power for touring service and one of from 2 to 4 candle-power for town service; and this is what has been done by several manufacturers. Obviously, two bulbs cannot be placed in the principal focus of a parabolic reflector, one being large and the other small, even if this were desirable. But it is not desirable for the effect of the small bulb, if placed directly in the focus, which would be magnified to too great an extent. It follows that the smaller of the two bulbs must be placed somewhere other than in the focus and this reduces to some extent the efficiency of the mirror when the larger of the bulbs is in use. The decrease in efficiency may be to all intents and purposes negligible, but it exists. When the side lamps are removed there is removed also a warning of the presence of the car to those approaching from the sides. Even when side lamps have no side "window" through which their light may shine and thus serve as a warning, their beams, even when but faintly reflected from the engine hood and fenders, serve this purpose. But when smaller bulbs are placed in the head lamps their beams are not always intense enough to be seen of themselves—and there is nothing from which they may be reflected.

Fig. 4.—Pilgrims' badges of the twelfth century. Two of these are whitened by corrosion, while the third is intact.

[1] See SCIENTIFIC AMERICAN, June 25th, 1910.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A New Union for Piping Systems

MODERN demands necessitate higher water and steam pressures in large buildings, greater hydraulic pressures in mills and factories, and generally harder conditions in all piping systems. This is substantiated by the fact that all pipe manufacturers have adopted standard full weight pipe, refusing longer to put on the market the light weight merchant pipe.

The fittings ordinarily used are heavy cast iron, and the couplings furnished with the pipe are made of forged iron. On account of the requirements of form and the abuse given them, unions used on piping systems up to the present time have been made of malleable iron, and have been the weakest link in the piping systems.

Mr. Charles A. Dies of Chicago, Illinois, the inventor of a new union, in common with many others, was aware of the limitations of existing pipe unions, and saw that there would be a big field for one which would give satisfactory and uniform service, and which would meet the ever-increasing demands for stronger and better piping systems.

Other inventors and manufacturers of unions, like Mr. Dies, recognized that the union was not suitable for the service, and have made many different attempts to improve the article. Most of these attempts were along the lines of changing the design, although in some cases hot forged steel unions have been made successfully. These eliminated most of the defects of cast unions, which had a tendency to be full of blow holes, cracks or shrinks which made them undependable. Forged unions overcame also to some extent the trouble with all malleable unions due to their unequal expansion and contraction with the steel pipe with which they are connected. The great trouble with the hot-forged union, however, was that its cost was so great as to make it almost prohibitive.

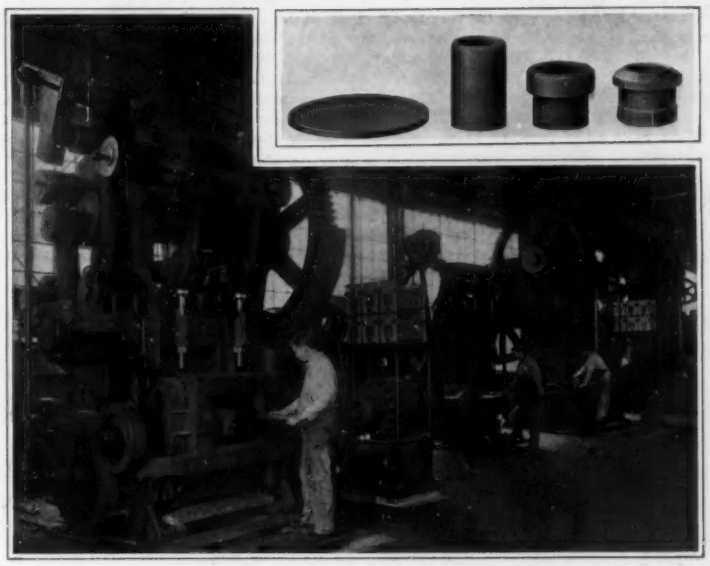
Flanged unions were tried, and are largely used to-day, the only objection being that they are too heavy and cumbersome, as well as very expensive.

Mr. Dies, using his knowledge of metal drawing and forging, went at the problem of devising a stronger union by choosing a new material, instead of trying to make a better union than the others from a casting. He accomplished this by drawing the various parts from cold flat strips of rolled open hearth steel. We illustrate four stages in the process of forming the male end. The first operation punches from the flat strip, a disk or blank of suitable size. This blank is then cupped and redrawn into a deep cup or cylinder, from which the bottom is punched to form a seamless tube, as shown in the second illustration. One end of this is then folded or rolled back on itself to form a reinforcement for the seat pictured in the next figure. Further operations compress and shape this seat, and put the beading on the lower end as seen in the fourth engraving.

The female end is formed similarly, the differences coming in the last few operations, which alter the shape of the seat. The seat or joint between the ends of the union consists of the hardened and densified seat of the male end opposed to a soft brass seat or cushion drawn from dead soft sheet brass, and forced into place in the finished female end. This gives an ideal combination—a hardened steel seat against a soft brass seat.

All the forming operations are performed upon the metal while it is cold, and the seats are not machined or ground in any way, but depend for their accuracy and form entirely upon the pressure applied to them in the presses. Some of these presses are illustrated in the accompanying engraving.

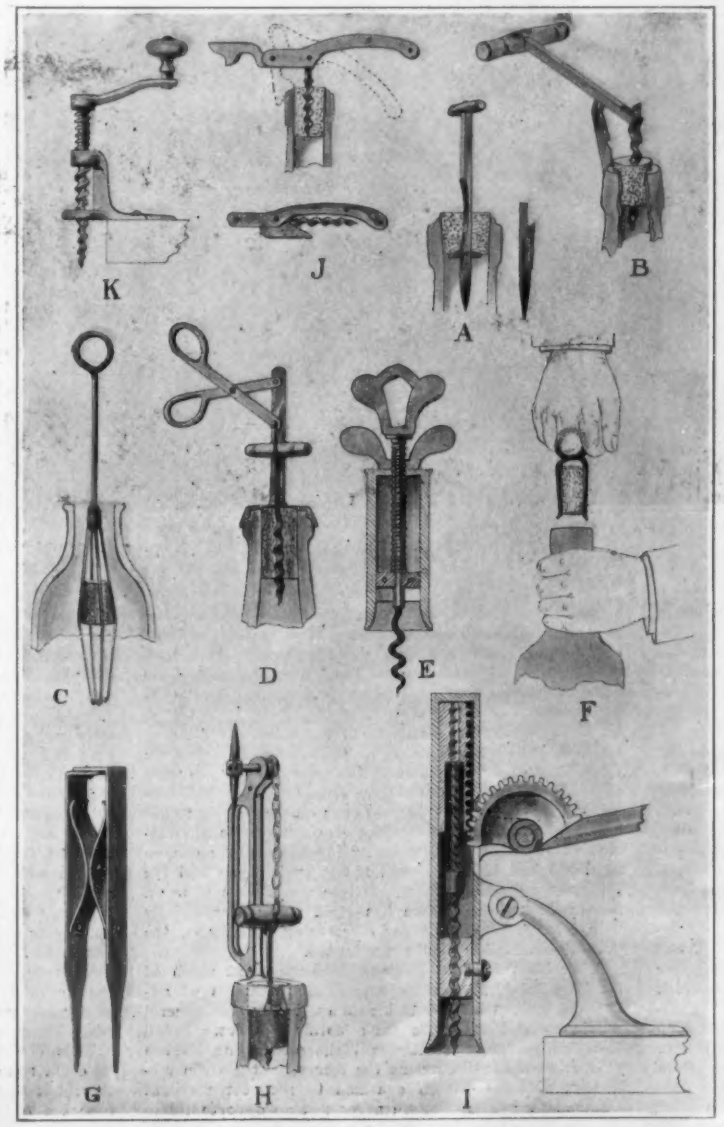
The threading is done in specially constructed machines, and the internal threads on the male and female ends are tapered to a Briggs Standard pipe thread, while the threads on the coupling nut are cut straight. The entire union, except the brass cushion, is sherardized after all the threading is done, so that every part of the surface is rendered rust-proof.



Presses with which the unions are made. The insert shows four stages in the process of manufacture.

Some Old Cork Extractors

THE necessity of some form of cork extractors is experienced by all, and it may be interesting to review some of the well known implements shown in the accompanying illustration, all of the devices pictured being found among the expired patents.



A selection of old cork extractors found among expired patents.

In *A* we find a device having a shank pierced at its lower end to penetrate through a cork, and provided with a short pivoted cross bar for alining with the shank as the last is forced through the cork, but turning at a right angle to withdraw the cork.

The corkscrew *B* has the handle pivoted to the screw part and a prop is also pivoted to the handle and it may be rested against the bottle lip to form a fulcrum for the handle so that the last can operate as a lever to pull the cork; while *C* illustrates a simple wire cage for withdrawing corks that have been forced down into a bottle.

A double lever in scissors shape is presented in *D*, and this can be used in connection with any handled corkscrew. The sketch *E* shows a stand to rest upon a bottle, and having a threaded shaft carrying the screw and a separate nut operating on the threaded shank to pull the cork.

Simple extractors having blades to project down on opposite sides of the cork, are represented in *F* and *G*. Sketch *H* shows an extractor in which a stand mounted on the bottle neck has at its upper end a windlass connected by a chain with the corkscrew, so that it can exert force to pull the cork.

In *I* is shown an extractor adapted to be secured to a bench or counter and supplied with a hand lever, whose rack segment operates when moved in one direction to force the corkscrew into the cork, and when reversed, to pull the cork out of the bottle so as to free the cork from the screw.

J represents a novel form of corkscrew which can be folded as shown in the smaller engraving to conveniently carry in the pocket, and can then be opened as shown in the larger one, to operate first as a handled corkscrew in turning the screw into the cork and then as a lever in extracting the cork from the bottle; and *K* presents a bench or counter extractor in which a screw turns into the cork and a spring when compressed aids in drawing the cork from the bottle.

Notes for Inventors

Fillings for Artificial Dentures.—In patent No. 1,070,442, Ernest Fogg of Newcastle-upon-Tyne, England, provides separate filling-pieces which fit and are secured in the interstices between adjacent teeth and fill such spaces.

An Imitation of Pieced Fur Skins.—Richard J. Steiner of Philadelphia has patented, No. 1,069,588, a method of producing imitation pieced fabrics in which the nap of a pile fabric is laid in certain sections in a different direction from other sections with the individual sections subdivided by suture lines formed in the nap of the fabric.

A Self-releasing Bowling Ball Handle.—In a patent, No. 1,068,389, to John W. Hyatt of Newark, N. J., is presented a bowling ball handle which has a movable device for locking the handle to the ball. A cord connects the device with the wrist of the bowler so that when the handle is released in delivering the ball the cord will operate to release the movable device and so free the handle from the ball.

Multi-color Lights for Moving Pictures.—A projecting apparatus for moving pictures has been patented, No. 1,070,699, by Isidor Kitsee of Philadelphia, in which a plurality of electric lights each producing a light of different color from the others, and which may be extinguished and energized in succession, said lights being controlled in a predetermined order by means operatively related to the film advancing means.

Alfred Russel Wallace

Co-Founder, With Darwin, of the Modern Theory of Evolution

By Benjamin C. Gruenberg

THE remarkable fact that two men at opposite ends of the earth had worked out, unknown to each other, an identical solution to the problem of the genesis of species, has been so often told that it hardly needs to be repeated. Each of these two men, with a modesty that is rare even among scientists, constantly insisted that all honor for the great discovery was due to the other. For many years they lived in friendly communion—and nowhere is there the slightest indication of envy or jealousy. One of these men, Charles Darwin, died in April, 1882; the other, Alfred Russel Wallace, has just passed away.

Alfred Russel Wallace was born in Usk, Monmouthshire, England, on January 8th, 1823. He received an elementary education in a local grammar school, and from the time he was fifteen years old he got his education without any schooling. For six years he was occupied in engineering and surveying operations with his older brother. During these years, in which he spent a large part of the time out of doors, he felt growing upon him an interest in the plants and animals that he came across and took great delight in learning the names of new forms. He cultivated this interest so that out of it developed a large part of his life work.

In 1844 he was a teacher of English at the Collegiate Institute at Leicester. This was an important year for him, as in it occurred a few trifling events that turned the whole course of his life. It was here that he became acquainted with Henry Walter Bates, a clerk in Allsopp's brewery; here that he read Humboldt's "Personal Narrative of Travels in South America," which aroused in him a strong desire to visit the tropics, a desire strengthened later by reading Darwin's account of the voyage of the "Beagle," and here that he read Malthus's "Essay on Population."

The brewery clerk and the school teacher both appear to have had souls, and a common interest in the world of living things. In 1848 Bates and Wallace went to Para, and for two years they explored together along the Amazon, making valuable collections and notes. They then parted company, Bates continuing his exploration to the south for seven years longer, and Wallace to the north for two years. A fire on board the rubber ship destroyed his collections and most of his notes, but he courageously set to work to write up his travels from some notes that were saved and from his recollections. His first book, "Travels on the Amazon and the Rio Negro," was published in 1853.

The following year Wallace started on his voyage to the Malay Archipelago, which occupied him until 1862. The observations and studies made during this period furnished the material for a large number of special monographs, and four rather large books of a more general character. These were "The Malay Archipelago," published in 1869, "The Geographical Distribution of Animals," published in 1876, "Tropical Nature," published in 1878, and "Island Life," published in 1880. Early in his Malay travels (1855) he wrote a short essay "On the Law Which Has Regulated the Introduction of New Species," in which he pointed out that new species had always made their appearance in regions occupied by similar species, and that the introduction had always been gradual. This was a vague approach to a general idea of evolution, but at this time there was nothing in Wallace's mind to correspond to the idea of "Natural Selection." But two years later, while incapacitated from work by an attack of intermittent fever, fragments of reflections that had passed through his head in years of solitude began to shape themselves about the Malthusian doctrine of the pressure of population upon subsistence. In a moment of inspiration he applied to the world of changing forms that he had been studying this conception of struggle for existence—and within two weeks his essay "On the Tendency of Varieties to Depart Indefinitely from the Original Type" was on its way to Darwin, with the request that the latter forward it to Sir Charles Lyell, the famous geologist. Now Charles Darwin had been at work on this very problem, and for nearly twenty years had been gathering materials to establish his theory, and we may well believe that he was somewhat discomposed on receiving from Wallace this summary of his own ideas. Darwin consulted Lyell and Joseph Hooker, the botanist, who had seen a sketch of his theory some thirteen years previously. On the advice of these two men he prepared an abstract of his theory, and this abstract was combined with Wallace's paper. Under the title "On the Tendency of Species to Form Varieties, and on the Perpetuation of Varieties and Species by Natural Means of Selection," this joint paper was presented to the Linnæan Society of London on the first of July, 1858, by Lyell and Hooker. On this occasion neither Darwin nor Wallace was present, the one being away from England and the other being kept at home by illness. Lyell and Hooker, on introducing the paper—which was read by the secretary—pointed out the importance of the questions raised and the significance of the solution offered; but such was the novelty of the ideas presented that there was absolutely no discussion.

Darwin was induced to hurry his work and to prepare a "brief abstract" of his theory. This brief abstract was published in November of 1859 as a "small book" of about 500 pages—"The Origin of Species." Since then the doctrine of "Natural Selection" has gone under the name of Darwinism. In a letter to Joseph Hooker written in 1858 Huxley writes:

"Wallace's impetus seems to have set Darwin going in earnest, and I am rejoiced to hear we shall learn his views at last. I look forward to a great revolution being effected." The communication from Wallace did certainly serve to accelerate Darwin's work; but it would be a serious mistake to suppose that the service of Wallace was confined to stimulating Darwin. There can be no doubt that if Darwin had not given to the world the theory of natural selection, Wallace would have done so. Among biologists Wallace has right along shared fully with Darwin the credit for discovering the law of the natural elimination of the unadapted.

After his return to England, Wallace spent much of his time in advancing the new ideas by means of addresses, reviews and special articles, before the general public as well as before the scientific societies. In all this struggle, so insistent was Wallace in giving Darwin all the honor for discovering the theory, that Darwin frequently declared himself ashamed to accept the credit. On the other hand, Darwin never lost an opportunity to explain Wallace's share in the theory. In 1870 Wallace published a collection of his essays, with some changes and additions, under the title "Contributions to the Theory of Natural Selection." The choice of this title is interesting as showing Wallace's devotion to Darwin and to the "cause," for some four years previously he had written to Darwin on the great amount of misunderstanding that had arisen from the use of the expression "natural selection," and suggesting the advantages of Herbert Spencer's phrase "survival of the fittest," which does not over-personify "nature."

Although Wallace was for over half a century the most persistent Darwinist among prominent men of science, he did not accept all of Darwin's views. In his book "Darwinism," published in 1889, he gave a clear exposition of the theory of natural selection and a summary of the evidence in its favor. In this book he also rejects some of Darwin's subsidiary theories. In place of Darwin's theory of sexual selection, he pointed out the protective value of dull plumage in female birds while sitting on the nests, and accounted for the differences between male and female birds, as regards plumage, solely as the result of natural selection. In this book he also reaffirmed his conviction that natural selection could account for the development of species in general, but he did not think the theory adequate when it came to man's higher faculties. At this point Darwin stood firm in his faith; Wallace considered a special act of creation necessary. Wallace differed from Darwin also on the latter's theory of Pangenesis, although when he first read of it he admired it very much, and found it a source of "positive comfort," as he wrote in one of his letters. And Darwin wrote that "Wallace sticks up for the great god Pan like a man."

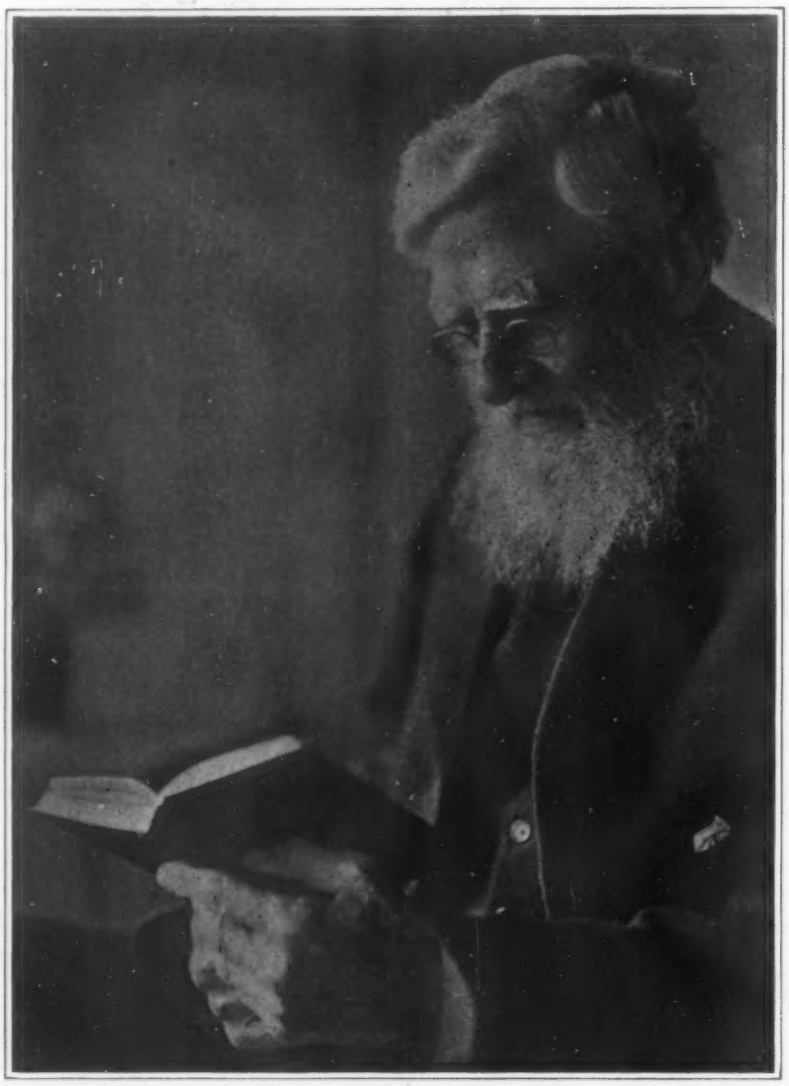
Among the other special contributions that Wallace made to the general idea may be mentioned his development of the theory of "Mimicry" (which was independently enunciated by Bates), the theory of warning colors, the theory of recognition marks and his correlation of the facts of geographical distribution of animals with the theory of evolution.

A thorough naturalist in the older sense of that term, Wallace was a comparatively ignorant man in those branches of biological science that have made such great strides in more recent times. He never studied anatomy, embryology or morphology, or even taxonomy in a thorough manner. His great interest was in the relations among organisms as they can be observed in the field or the forest. Of modern physiology he knew practically nothing. This special character of his interest in nature may account for the fact that in the later years of his life he found himself quite out of the current of evolutionary thought.

The writings on evolution during the earlier part of the Darwinian period were characterized by a speculative attitude of mind. The theories were of course supported by facts, but they were altogether facts of observation. During the latter part of this period the rigid method of the experiment was extended to the world of living things, and many observations and interpretations of the field naturalist, many reflections of the study were subjected to a more searching analysis. As a result, many of the theories that did valuable service in the third quarter of the last century were more or less completely replaced by others. This change is of course of the kind that must always take place in the progress of a science; and it is no discredit to a theory or to its originators that it must give way to another. The theory of natural selection must have permanent value in the thought of mankind, notwithstanding its failure to meet the expectations of its most partial advocates. That this theory does not adequately explain all the facts that Wallace attempted to explain with it does not discredit Wallace. His work consisted in helping to make the idea familiar to the following generation. In this he succeeded. He was unable to accept many of the newer ideas, partly because he had not the training in the more subtle branches of biology, partly because he was unable to reconcile these ideas with what he considered fundamental—natural selection.

Thus Wallace objected to the mutation theory because he could not harmonize it with the idea of natural selection; but also because he could not understand the significance of the evidence upon which the mutation theory

(Concluded on page 387.)



Photograph by Hoppe

ALFRED RUSSEL WALLACE

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Photography by Invisible Light

(Concluded from page 381.)

was: "Can we find any terrestrial mineral which behaves in the same way?" I photographed a large number of specimens of rock, many of them of volcanic origin, and finally found one to reproduce the behavior of the Aristarchus spot almost exactly. It was a yellowish gray volcanic tuff, identical in its appearance with another specimen of tuff, which, however, did not show the peculiarity of photographing dark in ultra-violet light.

I next made a chemical analysis of the small chip, and found that it contained iron and traces of sulphur, but photographs of rocks stained with iron had shown that the iron stains came out equally dark in violet and ultra-violet. There remained the sulphur, however, and to test this point a very thin deposit of sulphur invisible to the eye was formed on the surface of the larger piece of tuff, by directing a jet of sulphur vapor against it for a second or two. The fragment, when photographed by the three different types of rays, showed no trace of the deposit in the yellow picture, and only a faint trace of it in the violet one, but in the ultra-violet picture the deposit came out quite black. (See Fig. 6.) This makes it appear very probable that the dark deposit around the crater Aristarchus is due to sulphur, or to the presence of rocks containing sulphur. Its immense extent makes me think, however, that it is an actual deposit thrown down by an immense blast of gases from the crater.

The discovery of sulphur in the vicinity of a lunar crater is of considerable importance, since there has been a good deal of discussion as to whether the so-called "craters" are really of volcanic origin. Should further investigations reveal the presence of similar deposits in the vicinity of other craters, it would be a strong argument in favor of the volcanic theory, because sulphur is almost invariably found in regions which either are, or have been, centers of volcanic activity. It is a curious circumstance that but one of these deposits has been found thus far on the moon. Other smaller ones doubtless exist and can be picked up with a more powerful reflector.

In the laboratory I have been carrying on a variety of investigations with invisible rays. These for the most part have to do with rather abstruse problems in physical optics and spectroscopy, and I shall mention but a single case as illustrating how the ultra-violet rays can be utilized in rendering visible the vapor given off by a metal, even at the temperature of the room.

Mercury is known to give off a vapor that is very injurious to the health of workmen exposed continuously to the fumes. But it is of such extreme tenuity that a volume of air represented by a cube measuring nearly eight feet on each side, after it has taken up all of the vapor it can hold, contains only about a cubic inch of pure mercury vapor, such as is given off from the boiling metal. Notwithstanding the fact that even the pure vapor is absolutely invisible, and as transparent as air, it can, even when diluted with 800,000 parts of air, be photographed by the ultra-violet rays given off from a new type of lamp I have designed to meet the special requirements of the case.

This lamp, which I have named a resonance lamp, is nothing but a small bulb made of fused quartz, highly exhausted and containing a drop of mercury. The vacuum in this bulb is as perfect as can be obtained by any mercurial air-pump, and yet I have found that, if the ultra-violet light from a mercury arc be concentrated to a focus at the center of the vacuous space, the highly rarefied mercury vapor which fills the bulb emits ultra-violet light of feeble intensity, but of great purity. To this faint light emitted by the bulb the vapor of mercury is quite opaque, so much so, in fact, that we can photograph the vapor given off from the metal at room temperature, as is shown by Fig. 7, in which we have two pictures of a small quartz flask, empty in the first case, and in the second

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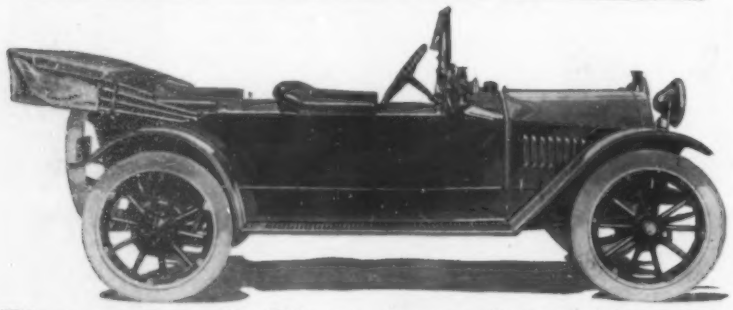

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containing a droplet of mercury about the size of a pin-head. This tiny drop gives off its vapor, which diffuses into the air in the flask, rendering it opaque to the light from the resonance lamp; consequently the air in the flask appears like dense black smoke in the photograph. The third picture in the same figure is a photograph of the vapor rising into the air of the room from a small drop of mercury placed on the top of a cylinder of brass, which was slightly warmed to cause the vapor to rise like smoke. These photographs show us that it is possible by means of photography with invisible rays to study the behavior of a metallic vapor at very low pressures with great precision.

Ultra-violet photography I have found furnishes us a means of detecting alterations made in manuscripts and so-called "raised checks." The best chemical ink erasers remove the writing and leave absolutely no visible stain or other evidence upon the surface of the paper, and photography, by any of the usual methods, shows no evidence of tampering. If however we photograph the manuscript with ultra-violet light, the spot upon which the eraser has been used shows up in the picture as a dark smudge, for the chemical has given to the paper the power of absorbing the invisible rays, just as ordinary ink causes it to absorb visible light.

A sample of a raised check was prepared for me by a well known authority on questioned documents. The check originally called for twenty-four dollars, but it had been raised to twenty-four hundred by erasing the heavy ink line drawn after the twenty-four and insertion of the word hundred. I was unable to detect any sign of alterations and the cashier of one of our largest banking houses, to whom I showed it, said that it appeared to him to be all right. The photograph made with ultra-violet light told the story however in a manner that would convince any jury. The original writing and the ultra-violet photograph of it are reproduced in Fig. 8.

The advantage of this method lies in the fact that the manuscript is not injured in any way by the examination, as is the case when chemical treatments are resorted to to show the use of an ink eraser, for it is often of importance to conceal the fact that the document has been questioned.

In the case of a certain disputed document which was submitted to me recently, the ultra-violet rays actually brought out traces of the erased words. A mercury lamp of fused silica was used for illuminating the manuscript, and the quartz lens used for photographing it was silvered with a film thick enough to render a tungsten lamp invisible through it.

My experiments with the infra-red rays have been confined thus far to the photography of landscapes, though I have no doubt that interesting data could be obtained by applying the method to celestial photography, for these rays have a remarkable power of penetrating a planet's atmosphere without suffering diffusion. In photographs made by the infra-red rays, green vegetation in full sunlight comes out as white as snow, while a clear blue sky appears almost as black as midnight. This is due to the circumstance that the rays come through our atmosphere without being scattered, for it is scattered light that gives the sky its color and luminosity. I have recently obtained some very fine examples of these infra-red photographs in Sicily and Italy, some of them being extremely decorative. In Fig. 9 we have a view taken at the bottom of the Latomia of Syracuse. This is the ancient quarry, in which the conquered Athenian army was imprisoned, and the view was taken looking out through the mouth of a cave-like formation at a group of young almond trees, with which the bottom of the quarry is overgrown. The green foliage comes out white, as if the trees were in blossom, and the sky near the top of the picture is almost as dark as the deep shadows within the cave. It is only a very clear blue sky that comes out black and if we follow

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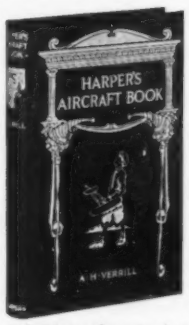

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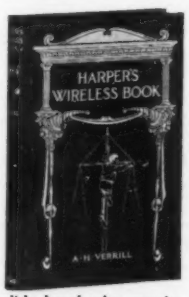

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it down to the horizon where the haze is whiter, we see that it brightens perceptibly. A fine row of trees in the park of Florence is shown in Fig. 10, the end of the vista appearing quite as sharp and lacking in "atmosphere" as the foreground, owing to the penetrating power of the rays.

In Fig. 11 we have an old gate and a row of cypress trees on the road to Grasena, just outside of Florence. In this case the sky was not quite free from haze, and in consequence is not quite as dark as in the other pictures. Nevertheless even the very dark green of the cypress foliage comes out brighter than the sky.

I received so many letters asking for particulars regarding the method of making the infra-red pictures, that a few words regarding the technique may not be out of place. They can be made with any camera provided with a ray filter (glass-cell) that can be filled with a solution. A saturated solution of bichromate of potash is put into the cell, and a strong solution of the aniline dye "cyanine" added until the color of the transmitted light is a very dark blood red. The screen can be tested by looking at sunlit foliage against a dark blue sky, covering the head entirely with a black cloth to cut off all rays except those which come through the screen. The leaves should appear much brighter than the sky, and, if they do not, more cyanine must be added. This screen is placed in front of the lens, and an exposure of from three to five minutes given with an F 8 stop on a Cramer "Spectrum" plate. Ordinary ortho or trichromatic plates will not do. In England a spectrum plate is manufactured by Wratten & Wainwright.

These rays, which I have for convenience termed infra-red rays, are not quite invisible, though they have such a feeble action on the retina as to play no part in ordinary vision, and we can see objects by them only when the eyes are carefully protected from other light. The true infra-red rays lie just beyond these deep red rays, though we cannot draw any sharp line between them, for eyes vary much in sensibility in this region of the spectrum.

It seems not unlikely that photographs of the planets taken by these rays will prove interesting, owing to their power of penetrating an atmosphere illuminated by sunlight. If a planet is surrounded by a light-scattering atmosphere, as is the earth, we can see its surface only through a luminous haze, which would be wiped out, to a certain extent at least, if we utilized only the infra-red rays in making our observations.

It is my hope that experiments in this direction will be made with some of the larger photographic telescopes. I especially commend the case of Mars, the appearance of whose surface certainly suggests that we are viewing it through a somewhat luminous atmosphere.

It is easy to see, from the few cases I have cited, that things appear to us as they do merely from the circumstance that our eyes happen to be sensitive to a definite region of the spectrum.

Alfred Russel Wallace

(*Concluded from page 384.*)

rested. In the same way he failed to appreciate the importance of the laws of heredity discovered by Gregor Mendel and later rediscovered independently by the Dutchman DeVries, the German Correns and the Austrian Tschermak, because he did not differentiate these laws from what had been known to Darwin, and because he could not see their application to the problem of evolution of organic forms. He also failed to appreciate the distinction between different classes of "variations" that have been forced upon us in part through mathematical studies and in part through breeding experiments. In all these cases, and some others, Wallace stood by the old as opposed to the new ideas.

Whoever accepts the principle of evolution must recognize that it applies to human ideas as well as to institutions

The Chronology of Aviation

THE Scientific American has received from Mr. Hudson Maxim and Mr. William J. Hammer, a limited number of the reprints which they have just issued of the very complete "Chronology of Aviation," originally prepared by these gentlemen for the World Almanac of 1911. The data embrace the essential facts relating to aerial progress. In addition to a short historical *résumé*, one finds herein tables giving altitude records, speed records, quick starting and slow-speed records, passenger carrying, English Channel and other over-water flights, cross-country flights, notable distance and duration flights, etc. There are also statistics relating to accidents and data relative to spherical and dirigible balloons or airships, etc. Of no small interest are the tables giving the most important flights of the Wright brothers. There are doubtless many readers of the Scientific American who are much interested in this subject and who would be glad to secure a copy of this interesting brochure. They can do so by applying to the Aeronautic Editor of the SCIENTIFIC AMERICAN, 361 BROADWAY, NEW YORK

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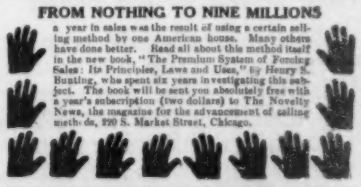

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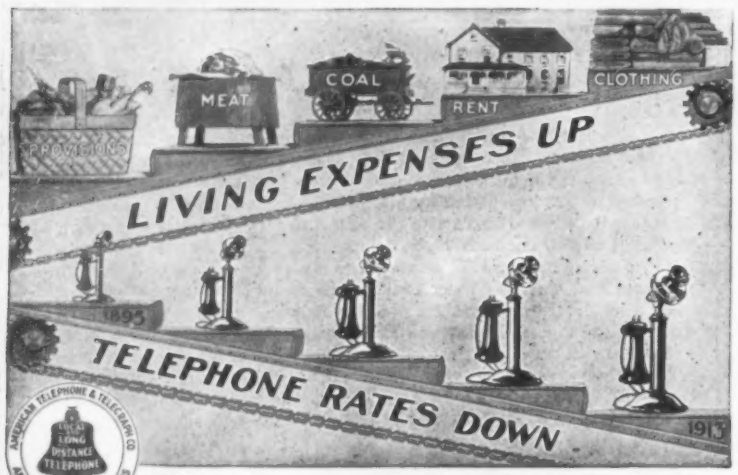

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and to battleships. The thorough evolutionist will be prepared to have his ideas give way to new ones. Many of us are evolutionists, but not many are as thorough as that. The times change, but we do *not* all or always change with them. Wallace had stopped changing some years before his death.

Through the efforts of a number of friends, led by Charles Darwin, a civil pension was obtained for Wallace in 1881, in recognition of his services to science. With this and the income from his writings he was able to live quietly without engaging in the struggle for a livelihood, for unlike Darwin he had no independent income. He resided in various parts of England for over thirty years. In 1886 he visited this country to deliver the Lowell lectures.

Far from being a narrow pedant, wedded to his specialty to the exclusion of other matters, Wallace was a man of broad interests and deep sympathies. As an indication of the wide range of his intellectual activities, it may be worth while to note that he devoted a great deal of time to the study of the so-called "psychic phenomena," and wrote a book on the subject called "Miracles and Modern Spiritualism" (1875). He believed the subject to be of vital importance and tried to induce Huxley, Tyndall and other scientists to undertake a serious study of the matter. He succeeded only in convincing them that the frauds which they discovered were an integral part of the whole business. He was interested in many social problems, but here, too, showed his inability to make a sound analysis of the phenomena, for he was at one and the same time a "Single-taxer" and a "Socialist." For a number of years he was president of the Land Nationalization Society, and in 1882 published a book on the land question called "Land Nationalization; Its Necessity and Its Aims." His failure to understand the physiology of modern medical discoveries is shown by his espousal of the anti-vaccination cause, for which he also wrote a great deal.

Among his later publications are "The Wonderful Century; Its Successes and Its Failures" (1899), "Studies, Scientific and Social" (1900), "Man's Place in the Universe" (1903), in which he tried to show that the earth was the only inhabited celestial body, was in the center of the universe, and that man was the aim and end of the whole cosmic process, and an autobiography in two volumes called "My Life" (1905).

On the fiftieth anniversary of the reading of the Darwin-Wallace paper before the Linnæan Society, this body held a special meeting and conferred upon Wallace a gold Darwin-Wallace medal. Copies of this in silver were presented to Sir Joseph Hooker, the only man who was present at both of these memorable meetings, and to Francis Galton, Ray Lankester, August Weismann, Ernst Haeckel, and Edouard Strasburger. Never connected with any university, either as student or as instructor, Wallace was honored by special degrees from a number of institutions.

An able man and a hard worker, he leaves his writings as a monument to his industry and to his devotion to the advancement of truth. An intensely human man, he had a host of friends, among those who agreed with him, and also among those who did not.

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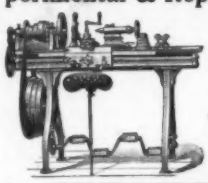

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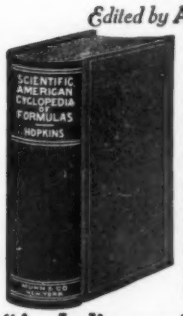

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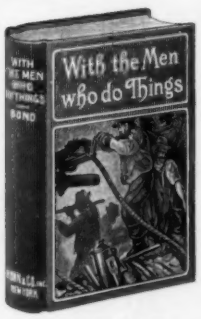

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